PROJECT PLANNING AND INSTALLATION MANUAL

HEAT PUMPS WITH SIMPLIFIED CONTROLLER

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  - Heating and cooling with heat pumps
  - Heat pumps with simplified controller

Dimplex
INNOVATIVE HEATING AND COOLING

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1 Selection and Dimensioning of Heat Pumps for Heating and Cooling

1.1 Calculating the Heat Consumption of the Building

The maximum hourly heat consumption $\dot{Q}_h$ is calculated according to respective national standards. It is possible to estimate the approximate heat consumption using the living space A (m2) that is to be heated:

$$\underset{[kW]}{\text{Heat consumption}} = \underset{[m^2]}{\text{Heated area}} \cdot \underset{[kW/m^2]}{\text{Specific heat consumption}}$$

$\dot{q}$ = 0.03 kW/m^2	Low-energy house
$\dot{q}$ = 0.05 kW/m^2	Acc. to thermal insulation ordinance 95 or the EnEV (Energy Saving Regulation) minimum insulation standard
$\dot{q}$ = 0.08 kW/m^2	For a house with normal thermal insulation (built approx. in 1980 or later)
$\dot{q}$ = 0.12 kW/m^2	For older walls without special thermal insulation

Table 1.1: Estimated specific heat consumption values for Germany

1.1.1 DHW heating

To meet normal requirements regarding comfort, allowance should be made for a peak hot water consumption of approx. 80-100 litres per person per day based on a hot water temperature of 45 °C. In this case, allowance should be made for a heat output of 0.2 kW per person.

The maximum possible number of persons should be assumed when dimensioning and any special usage (e.g. whirlpool) should also be taken into consideration.

The heat pump manager regulates domestic hot water preparation. It activates hot water preparation depending on need and the type of operation.

When an electrically-operated flange heater is used in the hot water cylinder for hot water preparation, this can be used in the calculation of the design (e.g. -16 °C). In this case, the heat output for DHW preparation should not be added to the heating load.

Dimensioning flow temperatures

When dimensioning the heat distribution system of a heat pump heating system, it should be borne in mind that the required heat consumption should be based on the lowest possible flow temperatures, because every 1 °C reduction in the flow temperature for the same heating consumption yields a saving in energy consumption of approx. 2.5 %. Extensive heating surfaces such as underfloor heating or fan convectors with maximum flow temperatures of about 40 °C are ideal.

Circulation pipes

Circulation pipes immediately provide hot water at the extraction point, but this also considerably increases the amount of heat required for hot water heating. The increase in consumption which should be allowed for is dependent on the runtime, the length of the circulation pipes and the quality of the pipe insulation. If a circulation system can not be dispensed with because of long pipe runs, a circulation pump should be used which can be activated by a flow sensor, pushbutton, etc. if required.

⚠ ATTENTION!

Circulation pipes increase the number of requests for hot water due to heat losses. In case of active cooling, every request for hot water causes an interruption of the cooling operation (see *Chap. 7.4.3 on p. 50*).

1.2 Method for Calculating the Cooling Requirements of the Building

Cooling systems are used to prevent rooms from overheating due to the effects of undesired heat loads. The cooling capacity is determined primarily by the outdoor climate, the requirements for the indoor environment, the internal and external heat loads, as well as the orientation and the construction of the building.

⚠ ATTENTION!

Due to the strong influence of solar radiation and internal heat loads, it is not possible to make an estimate of the cooling requirements simply on the basis of the surfaces to be cooled.

Internal loads include e.g. waste heat from appliances, lighting as well as the occupants themselves. **External loads** are defined as the heat input caused by solar radiation, transmission heat gains from the surfaces enclosing rooms as well as ventilation gains caused by the entry of warmer air from outside.

The cooling load in air-conditioned rooms is calculated according to the respective national standards. In Germany, for example, the national standard is VDI 2078 (VDI cooling load regulations). This guideline contains two calculation methods (the “short method” and the computer method) as well as additional information for calculating the cooling load of air-conditioned rooms and buildings. The computer method does not serve to improve accuracy for standard conditions. However, it can be used to expand the range of applications to include almost any boundary conditions (variable blind systems, room temperature, etc.). In actual use, this method is too complex for standard conditions.

In the case of simple types of buildings such as offices, doctors' practices, shops or private residences, it is practical to make a rough calculation with values based on past experience or using the so-called HEA short method from the German “Fachverband für Energie-Marketing und - Anwendung e.V.” (English: Trade Association for Energy Marketing and Use).

i NOTE

Visit www.dimplex.de to use our online planner to calculate the approximate cooling load.

The values specified by this method are calculated on the basis of the VDI 2078 cooling load regulations. The calculation is based on a room temperature of 27 °C, an external temperature of 32 °C and continuous operation of the cooler.

NOTE

The cooling requirements of the building are calculated by adding up the cooling loads of the individual rooms. Depending on the type of building, a simultaneity factor can be used under certain circumstances because rooms on the east and west sides do not have to dissipate solar heat loads simultaneously.

1.3 Checking the Operating Limits

1.3.1 Maximum Heat Output of the Heat Pump

If the heat consumption of the building is higher than its cooling requirements, the heat pump should be configured for heating operation. Then it must be checked if the cooling output of the heat pump system is higher than the cooling requirement of the building.

Chap. 1.3.3 on p. 6 shows possibilities for reducing the cooling requirements of the building calculated for each room.

If the heat consumption of the building is lower than its cooling requirements, the heat pump can also be configured for cooling requirements.

1.3.1.1 Monovalent operation

In this mode of operation, the heat pump covers the heat consumption of the building throughout the whole year - 100% - by itself. Brine-to-water heat pumps are normally operated in monovalent mode. Refer to the Device Information of the respective device for the actual heat outputs at each respective flow temperature and minimum heat source temperatures.

	Brine-to-water heat pump	Water-to-water heat pump
Maximum flow temperature	35°C	35°C
Minimum heat source temperature	Brine 0 °C	Ground water 10 °C
Operating point for determination of the heat output	B0 / W35	W10 / W35

Table 1.2: Example of calculating the heat output

1.3.1.2 Mono Energy Operation

Air-to-water heat pumps are primarily operated in mono energy systems. The heat pump should cover at least 95% of the heat consumption. At lower temperatures and high heat consumption, the electrically operated immersion heater is switched on automatically.

In the case of mono energy systems, dimensioning of the heat pump output has a particularly strong influence on the level of the investment and the annual heating costs.

The higher the annual energy demand for heating met by the heat pump, the greater the investment costs and the lower the annual operating costs.

For example:

Calculating the necessary heat requirements to dimension a heat pump for heating and cooling with central hot water preparation for 5 persons.

- Heat consumption of building to be heated **11 kW**
- Additional heat requirement for hot water preparation **1 kW**

Heat requirement + hot water preparation
= 11 kW + 1 kW **12 kW**

Dimensioning of a reversible air-to-water heat pump with mono energy operating mode:

The design is to be determined for the dimensioning of the heat pump. The design is made up, on the one hand, of the required heat consumption and, on the other hand, of the lowest possible external temperature (coldest day). This means that the heat pump system must cover the max. possible heat consumption (12 kW) at the min. possible external temperature (coldest day). The determined design is to be entered in the diagram with the various characteristic curves of the possible air-to-water heat pumps (see *Fig. 1.1 on p. 5* and *Fig. 1.2 on p. 5*) as intersection of heat consumption and minimum external temperature (section ①).

The further design is done via the external temperature-dependent heat consumption of the building. The latter is drawn in the diagram in simplified fashion as a straight line between the design and point 20 °C/0 kW. When using this procedure, it is assumed that no more heat consumption (straight line ②) exists above an external temperature of 20 °C (air intake temperature of the heat pump).

The intersection of the straight lines (design to the end point at 20 °C/0 kW) with the respective heating output curves determines the theoretical bivalence points when using the individual heat pumps (section ③). The bivalence point enables a statement to be made about up to which external temperature the heat pump can cover the entire heat consumption alone (above the bivalence point) and from which time the heating element must be theoretically activated (below the bivalence point). The bivalence point is often lower in practice because of actual usage (e.g. unheated bedrooms, kitchen or hobby room with reduced temperature).

NOTE

The remaining output of the heating element still required in the design may not exceed a max. value of 6 kW.

Examining the sufficient size of the installed heating element:

Total heat consumption at minimum external temperature (Design)

– Heat output of the heat pump at minimum external temperature

= Output of the electrical heating element, max. 6 kW

Assuming a minimum external temperature of -10 °C results in the following dimensioning for the chosen example:

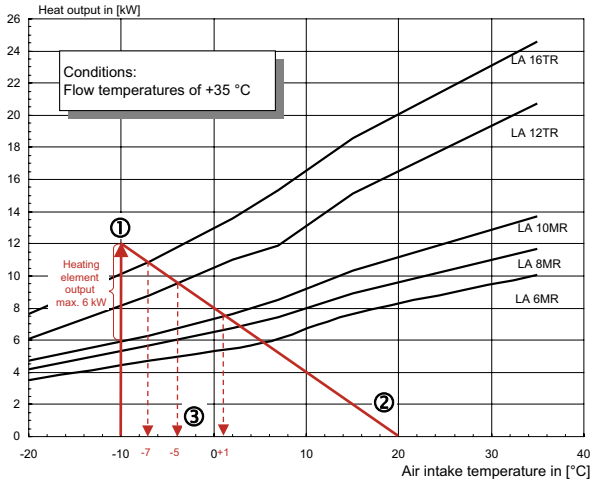


Fig. 1.1: Design of an air-to-water heat pump with heating element in mono energy operation for 12 kW heat consumption and -10 °C min. external temperature

The following options are then available:

- LA 16TR in combination with 2 kW additional output of the heating element and a theoretical bivalence point of -7 °C
- LA 12TR in combination with 4 kW additional output of the heating element and a theoretical bivalence point of -5 °C
- LA 10MR in combination with 6 kW additional output of the heating element and a theoretical bivalence point of 1 °C

The heat pump is then to be chosen according to the application and the climatic conditions of the region where the heat pump is to be installed.

Assuming a minimum external temperature of -10 °C results in the following dimensioning for the chosen example:

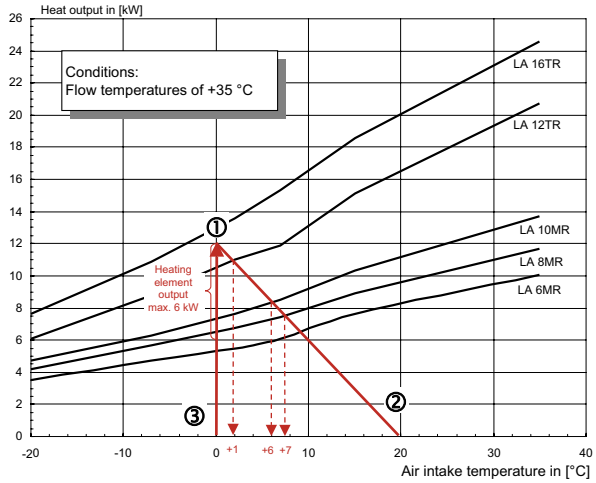


Fig. 1.2: Design of an air-to-water heat pump with heating element in mono energy operation for 12 kW heat consumption and 0 °C min. external temperature

The following options are then available:

- LA 12TR in combination with 2 kW additional output of the heating element and a theoretical bivalence point of +1 °C
- LA 10MR in combination with 4 kW additional output of the heating element and a theoretical bivalence point of +6 °C
- LA 8MR in combination with 6 kW additional output of the heating element and a theoretical bivalence point of +7 °C

The heat pump is then to be chosen according to the application and the climatic conditions of the region where the heat pump is to be installed.

Dimensioning of a reversible brine-to-water heat pump with mono energy operating mode:

In contrast to the mono energy operating mode of an air-to-water heat pump, the required heat consumption (12 kW) of a brine-to-water heat pump with monovalent operating mode must be covered by the heat pump alone. This means, the design of the brine-to-water heat pump must be adequate to cover the entire heat consumption.

The design of a brine-to-water heat pump is made up of the required heat consumption (section ①) on the one hand but, on the other hand, of the lowest possible brine inlet temperature (section ②). The design is to be entered in the diagram with the characteristic curves of the various possible brine-to-water heat pumps (see *Fig. 1.3 on p. 5*) as intersection of heat consumption and minimum brine inlet temperature.

The brine-to-water heat pump must then be chosen so that its heating output curve lies at or above the design.

Assuming a minimum brine inlet temperature of +3 °C results in the following dimensioning for the chosen example:

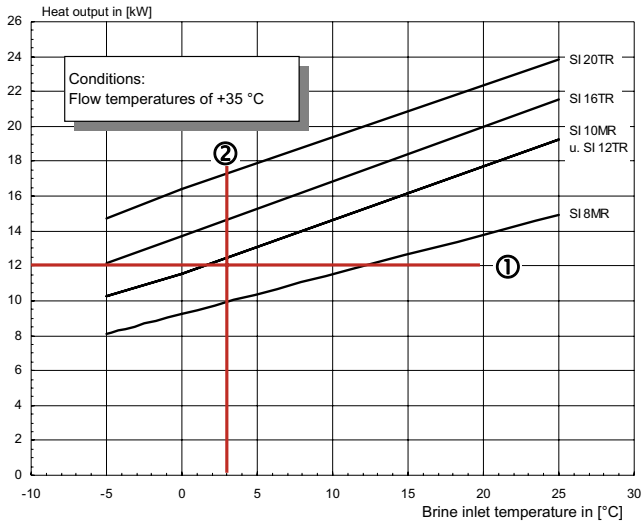


Fig. 1.3: Design of a brine-to-water heat pump in monovalent operation at 12 kW heat consumption and a minimum brine inlet temperature of +3 °C.

Based on the above boundary conditions, either the SI 10MR or SI 12TR can be chosen, depending on the existing power supply (single-phase or three-phase).

1.3.2 Maximum Cooling Capacity of the Heat Pump

If the maximum required cooling capacity of a building is already known (see also *Chap. 1.2 on p. 3*), it should be checked to ensure that the heat pump can supply this refrigerating capacity for the required boundary conditions. It is particularly important to check the operating limits of the particular type of heat pump used.

The cooling capacity of a reversible air-to-water heat pump is chiefly dependent on the required flow temperature and the outside air temperature. The higher the flow temperature and the lower the external temperature, the greater the cooling capacity of the heat pump.

For example:

What cooling capacity is available according to the output curve in *Fig. 1.4 on p. 6* at a max. external temperature of 35 °C?

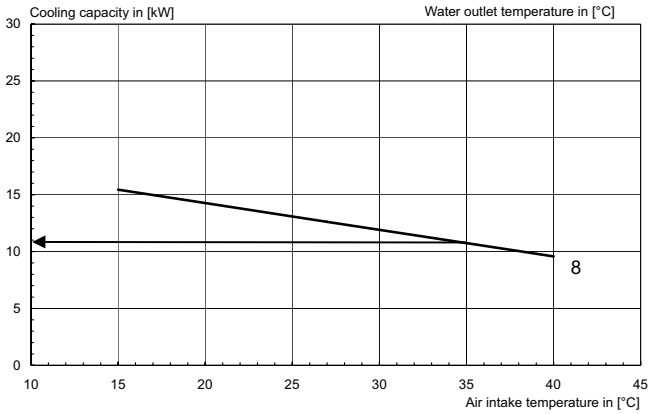


Fig. 1.4: Cooling capacity of a reversible heat pump (see also *Chap. 4.6 on p. 16*)

According to *Fig. 1.4 on p. 6*, this yields the following maximum cooling capacities based on flow temperatures in cooling operation:

Type of heat pump	Flow temp.	Cooling capacity
Air-to-water	18°C	14.3 kW
Air-to-water	8°C	10.7 kW

1.3.3 Measures to Reduce the Cooling Load of the Building

The building's cooling load is calculated by adding up the cooling loads of the individual rooms. If this sum exceeds the available cooling capacity, make a check of the following:

- Can the cooling load be reduced through simple building measures (e.g. by using external sunblinds)?
- Can the same cooling capacity also be supplied at higher flow temperatures by increasing the surface area of the heat exchanger?
- Are the calculated maximum cooling loads of the individual rooms actually to be calculated as being simultaneous, because, for example, rooms on the east and west sides are not heated simultaneously by solar radiation?
- Can the cooling load be reduced during the day by cooling parts of the building's structure at night (thermal activation of structural building parts)?

If despite these measures, the cooling capacity of the heat pump is still not sufficient, rooms with high heat loads can be equipped with supplementary air conditioners. For reasons of energy efficiency, these air conditioners should only operate when the heat pump can not cover the total cooling load.

2 Generation of Refrigerating Capacity

2.1 Passive Cooling with Ground Water

In compliance with the VDI 4640 standard, most regions welcome a cooling of the ground water e.g. through the use of a heat pump for heating purposes. Increasing the temperature by cooling, on the other hand, is only acceptable within strict limits.

A temperature of 20 °C must not be exceeded when the heat is discharged into the ground water. In addition, the temperature change of the ground water returned to the absorption well must not exceed 6 K.

2.2 Active Cooling

Heat pumps for heating purposes operate with a refrigerating circuit which can be reversed using a four-way reversing valve. In the case of these reversible heat pumps, an existing temperature level becomes “active”, i.e. it is cooled using the compressor output of the heat pump.

2.2.1 Active Cooling with Reversible Brine-to-Water Heat Pumps

Active cooling with reversible brine-to-water heat pumps and borehole heat exchangers is generally permissible up to a brine temperature of 21 °C in the heat exchanger (average weekly value) or a peak value of 25°C. Active cooling enables an increase in the cooling capacity and yields constant flow temperatures.

Heat exchanger design

The ground heat exchanger, which in **heating operation** serves as a heat source for the brine-to-water heat pump, should be designed according to the refrigerating capacity of the heat pump. This can be calculated using the heat output **minus** the electric power consumption of the heat pump as calculated in the design.

The heat output to be discharged in **cooling operation** is calculated using the cooling output of the heat pump **plus** the electric power consumption of the heat pump as calculated in the design.

NOTE

The heat output transferred to the ground heat exchanger in active cooling operation is higher than the refrigerating output extracted in heating operation.

2.2.2 Active Cooling with Reversible Air-to-Water Heat Pumps

Reversible air-to-water heat pumps utilise the inexhaustible supplies of outside air for both heating and cooling. This means that within the operating limits, it is only necessary to calculate the maximum cooling load, not the total cooling requirements of the entire cooling season. The refrigerating circuit of the heat pump can generate flow temperatures between 7 and 20 °C at an external temperature above 15 °C. These can be distributed in the building using a water-bearing pipe system.

Temperature outside air	Minimum	Maximum
Heating	-25°C	+35°C
Cooling	+15°C	+40°C

Flow temperature	Minimum	Maximum
Heating	+18°C	+58°C[1]
Cooling	+7°C	+20°C

1. at external temperatures to -10 °C and 40 °C at < -10 °C

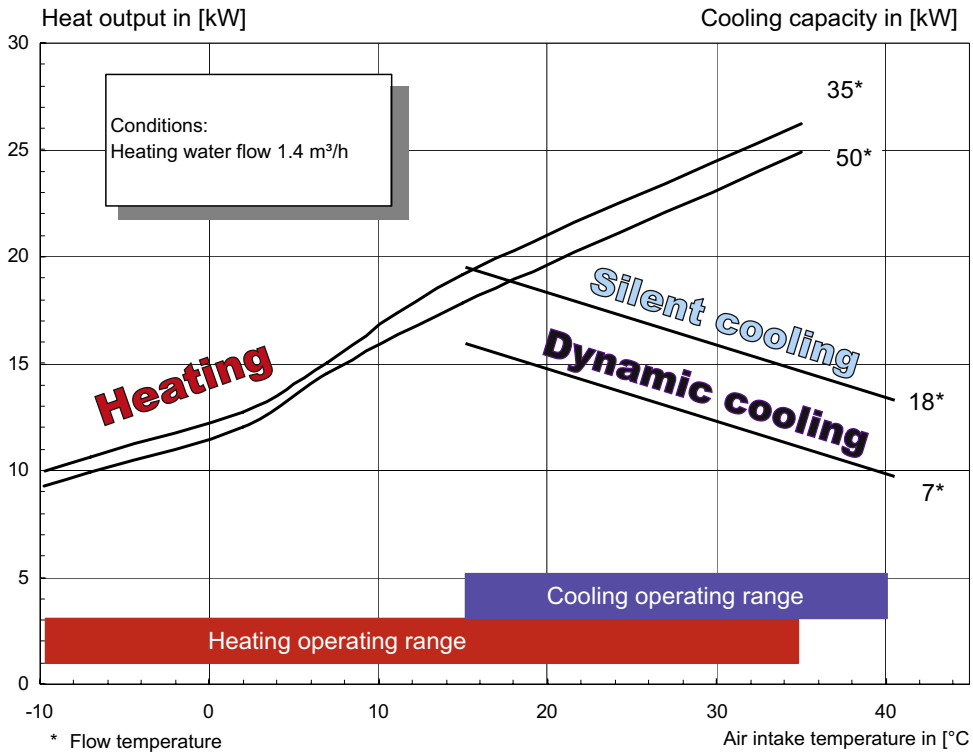


Fig. 2.1: Operating limits for a reversible air-to-water heat pump

3 Heating and Cooling with a Single System

3.1 Energy-Efficient Operation

In the same way that national standards demand building and system-specific measures for reducing the heating energy consumption, measures should also be taken to save energy by thermally insulating buildings for the warm summer months.

Cooling loads in any room that can nevertheless not be avoided using such measures can be discharged by introducing cooled air, by cooling the air using a heat exchanger installed in the room or by directly cooling structural parts of the building.

NOTE

In order to increase effectiveness, dimensioning of the combined heating and cooling system should be implemented with heating water temperatures that are as low as possible and cooling water temperatures that are as high as possible.

3.2 Hydraulic Integration of a Combined Heating and Cooling System

In heating operation, the heat output generated by the heat pump is transferred to a water-bearing pipe system via the circulating pump. Switching to the cooling mode transfers the generated refrigerating capacity to the heat distribution system which is also designed for distributing cold water (see *Chap. 8 on p. 52*). Making double use of the distribution system reduces the additional investment costs for cooling.

Depending on the type of cooling distribution system installed, cooling water flow temperatures can be reduced to a minimum of approx. 16 °C to 18 °C for surface cooling systems and approx. 8 °C for fan convectors.

ATTENTION!

A combined heating and cooling system must be insulated to prevent the formation of moisture in cooling operation. The pipes require insulation resistant against vapor diffusion.

3.3 Dynamic Cooling

The indoor air flows through a heat exchanger in which the cooling water is circulating. The use of flow temperatures below the dew point enables the transfer of greater cooling capacities by reducing the sensitive stored heat in the indoor air and simultaneously dehumidifying it by producing condensate (latent heat).

NOTE

A climate controller which has particular requirements regarding the humidity in a room can only be used in combination with an air-conditioning system with active humidification and dehumidification.

3.3.1 Fan convectors

Fan convectors that are designed as case, wall or cassette devices offer the option of dynamic cooling using a decentralized, modular system. Integrated ventilators ensure multi-level controllable air recirculation, variable cooling capacities and short response times. Fan convectors are not only used solely to cool the air, they can also be used for combined heating and cooling.

The cooling capacity of a fan convector is essentially dependent on the size, air volume flow, the relative humidity of the ambient air as calculated in the design, and the cooling water flow temperature and spread. If the requirements in the DIN 1946 T2 standard are taken into consideration when the device is dimensioned, specific cooling capacities ranging from 30 to 60 W/m^2 are feasible. By following the standard practice of dimensioning the device for a medium fan level, the user has the option of reacting quickly to varying heat loads (fast fan level).

Fig. 3.1: Fan convector for heating and cooling

NOTE

To ensure the minimum water flow rate through the chiller for all possible operating conditions, we recommend the use of fan convectors. These regulate using different fan levels, but do not reduce or block the water flow.

3.3.2 Cooling with Ventilation Systems

Besides dissipating heat loads, the required minimum air exchanges must also be ensured during cooling. A controlled domestic ventilation unit is a useful supplement to the cooling and can permit a **defined** exchange of air.

If necessary, the fresh air flow can be heated or cooled using so-called heating and cooling coils.

NOTE

Open windows should not be used for continuous ventilation in cooling operation for the following reasons:

- **It increases the heat load of the room**
- **The cooling capacity is often insufficient, particularly with silent cooling**
- **There is danger of condensate forming in the ventilation area around the window.**

4 Device Information for Air-to-Water Heat Pumps with Simplified Regulation

4.1 Air-to-water heat pump for outdoor installation

Device information for air-to-water heat pumps for heating purposes					
1	Type and order code			LAK 10M	
2	Design				
2.1	Design			Compact	
2.2	Degree of protection according to EN 60 529			IP24	
2.3	Installation location			Outdoors	
3	Performance data				
3.1	Operating temperature limits:				
	Heating water flow/return flow [1]		°C / °C	up to 58 +/- 2 / from 18	
	Air (heat source)		°C	-20 to +35	
3.2	Temperature spread of heating water (flow/return flow) at A7 / W35		K	10,9	5,0
3.3	Heat output / COP	at A2 / W35 [2]	kW / ---	8,1 / 3,4	8,0 / 3,2
		at A7 / W35 [2]	kW / ---	10,2 / 4,1	9,7 / 3,8
		at A7 / W45 [2]	kW / ---		8,7 / 3,1
		at A10 / W35 [2]	kW / ---	11,5 / 4,5	10,9 / 4,2
		at A-7 / W35 [2]	kW / ---		5,6 / 2,5
3.4	Sound power level		dB(A)	72	
3.5	Sound pressure level at a distance of 10 m (air outlet side)		dB(A)	46	
3.6	Heating water flow / internal pressure differential of		m³/h / Pa	0,8[3] / 1100	1,65[4] / 4500
3.7	Free compression of heat circulating pump (max. level)		Pa	65000	60000
3.8	Refrigerant; total filling weight		type / kg	R404A / 2.3	
3.9	Output of electric heating element (2nd heat generator)		kW	2.4 max. 6	
4	Dimensions, connections and weight				
4.1	Device dimensions		H x W x L mm	880 x 1285 x 695	
4.2	Device connections to heating system		Inch	Thread 1" external	
4.3	Weight of the transportable unit(s) incl. Packing		kg	185	
5	Electrical Connection				
5.1	Nominal voltage; fuse protection		V / A	230 / 25	
5.2	Heating element fuse[5]		A	30	
5.3	Starting current with soft starter		A	32	
5.4	Nominal power consumption [2]	A7 / W35	kW	2,5	2,6
5.5	Nominal current A7 / W35 / cosφ		A / ---	13,6 / 0,8	14,1 / 0,8
6	Complies with the European safety regulations			6	
7	Additional model features				
7.1	Defrosting			Automatic	
	Type of defrosting			Reverse circulation	
	Defrosting tray included			Yes (heated)	
7.2	Heating water in device protected against freezing			Yes [7]	
7.3	Performance levels			1	
7.4	Regulator internal/external			Internal	

1. For outside air between –20 °C to 0 °C, flow temperature increasing from 49 °C to 58 °C.
2. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, in particular the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values have the following meaning, e.g. A7 / W35: External air temperature 7 °C and heating water flow temperature 35 °C.
3. Recommended heating water flow rate
4. Minimum heating water flow rate
5. The electrical connection for the heating element requires its own mains cable with separate fuse.
6. See CE declaration of conformity
7. The heat circulating pump and the heat pump controller must always be ready for operation.

4.2 Reversible Air-to-Water Heat Pumps for Outdoor Installation, Single-phase

Device information for air-to-water heat pumps for heating purposes						
1	**Type and order code**			LA 6MR	LA 8MR	LA 10MR
2	**Design**					
2.1	**Design**			Reversible	Reversible	Reversible
2.2	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP24	IP24	IP24
2.3	**Installation location**			Outdoors	Outdoors	Outdoors
3	**Performance data**					
3.1	**Operating temperature limits:**					
	Heating water flow/return flow		**°C / °C**	up to 60 / above 18	up to 60 / above 18	up to 60 / above 18
	Cooling, flow[1]		**°C**	+7 to +20	+7 to +20	+7 to +20
	Air (heating)		**°C**	-20 to +35	-20 to +35	-20 to +35
	Air (cooling)[1]		**°C**	+15 to +40	+15 to +40	+15 to +40
3.2	**Heat output / COP**	**at A7 / W35 [2]**	**kW / ---**	6,1 / 3,3	7,4 / 3,3	8,5 / 3,4
		at A7 / W45 [2]	**kW / ---**	6,1 / 2,7	7,3 / 2,7	8,4 / 2,8
3.3	**Cooling capacity / COP**	**at A35 / W18**	**kW / ---**	7,9 / 3,2	9,4 / 3,3	11,1 / 3,3
		at A35 / W7	**kW / ---**	6,4 / 2,7	7,7 / 2,9	9,0 / 2,9
3.4	**Sound power level**	**dB(A)**		70,0	71,0	71,0
3.5	**Sound pressure level at a distance of 10 m (air outlet side)**		**dB(A)**	45,0	46,0	46,0
3.6	**Heating water flow**		**m³/h**	1,1	1,3	1,5
3.7	**Free compression of heat circulating pump (max. level)**		**Pa**	34800	35600	33800
3.8	**Refrigerant; total filling weight**		**type / kg**	R407C / 1.5	R407C / 2.3	R407C / 2.7
3.9	**Max. output of electric heating element (2nd heat generator)**		**kW**	6	6	6
4	**Dimensions, connections and weight**					
4.1	**Device dimensions**		**H x W x L cm**	86 x 127 x 67	86 x 127 x 67	86 x 127 x 67
4.2	**Device connections to heating system**		**Inch**	Thread 1" external	Thread 1" external	Thread 1" external
4.3	**Weight of the transportable unit(s) incl. Packing**		**kg**	159	165	170
5	**Electrical Connection**					
5.1	**Nominal voltage; fuse protection**		**V / A**	230 / 20	230 / 20	230 / 25
5.2	**Heat element fuse (230 V devices only)**		**A**	30 [3]	30 [3]	30 [3]
5.3	**Nominal power consumption [2]**	**A2 W35**	**kW**	1,9	2,3	2,5
5.4	**Starting current with soft starter**		**A**	26	32	38
5.5	**Nominal current A2 W35 / cosφ**		**A / ---**	10.3	12.5	13.6
6	**Complies with the European safety regulations**			[4]	[4]	[4]
7	**Additional model features**					
7.1	**Defrosting**			Automatic	Automatic	Automatic
	Type of defrosting			Reverse circulation	Reverse circulation	Reverse circulation
	Defrosting tray included			Yes (heated)	Yes (heated)	Yes (heated)
7.2	**Heating water in device protected against freezing**			Yes [5]	Yes [5]	Yes [5]
7.3	**Performance levels**			1	1	1

1. See operating limits diagram
2. This data indicates the size and capacity of the system. For an analysis of the economic and energy efficiency of the system, other parameters, such as, in particular, defrosting capacity, bivalence point and regulation, should also be taken into consideration. The specified values have the following meaning, e.g. A7 / W35: external air temperature 7 °C and heating water flow temperature 35 °C.
3. The electrical connection for the heating element requires its own mains cable with separate fuse.
4. See CE declaration of conformity
5. The heat circulating pump and the heat pump controller must always be ready for operation.

Device information for air-to-water heat pumps for heating purposes

1	**Type and order code**			LAK 10M
2	**Design**			
2.1	**Design**			Reversible
2.2	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP24
2.3	**Installation location**			Outdoors
3	**Performance data**			
3.1	**Operating temperature limits:**			
	Heating water flow/return flow [1]		**°C / °C**	up to 58 +/- 2 / from 18
	Cooling, flow[2]		**°C**	+7 to +20
	Air (heating)		**°C**	-20 to +35
	Air (cooling)[2]		**°C**	+17 to +40
	Heating water temperature spread according to EN 14511	**at A7 / W35**	**K**	5
3.2	**Heat output / COP**	**at A7 / W35** [3]	**kW / ---**	9,3 / 3,8
		at A7 / W45 [2]	**kW / ---**	9,0 / 3,0
3.3	**Cooling capacity / COP**	**at A35 / W18**	**kW / ---**	10,0 / 2,8
		at A35 / W7	**kW / ---**	7,8 / 2,2
3.4	**Sound power level**		**dB(A)**	71
3.5	**Sound pressure level at a distance of 10 m (air outlet side)**		**dB(A)**	46
3.6	**recommended heating water flow rate / minimum heating water flow**		**m³/h**	1,6 / 4500 | 0,8 / 1100
3.7	**Free compression of heat circulating pump (max. level)**		**Pa**	33800
3.8	**Refrigerant; total filling weight**		**type / kg**	R407C / 2.4
3.9	**Output of heating element adjustable (2nd heat generator factory setting 2 kW)**		**kW**	2.4 max. 6
4	**Dimensions, connections and weight**			
4.1	**Device dimensions**		**H x W x L cm**	86 x 127 x 67
4.2	**Device connections to heating system**		**Inch**	Thread 1" external
4.3	**Weight of the transportable unit(s) incl. Packing**		**kg**	170
5	**Electrical Connection**			
5.1	**Nominal voltage; fuse protection**		**V / A**	230 / 25
5.2	**Heat element fuse (230 V devices only)**		**A**	30 [4]
5.3	**Nominal power consumption** [2]	**A2 W35**	**kW**	2,4
5.4	**Starting current with soft starter**		**A**	38
5.5	**Nominal current A2 W35 / cosφ**		**A / ---**	13,6
6	**Complies with the European safety regulations**			[5]
7	**Additional model features**			
7.1	**Defrosting**			Automatic
	Type of defrosting			Reverse circulation
	Defrosting tray included			Yes (heated)
7.2	**Heating water in device protected against freezing**			Yes [6]
7.3	**Performance levels**			1

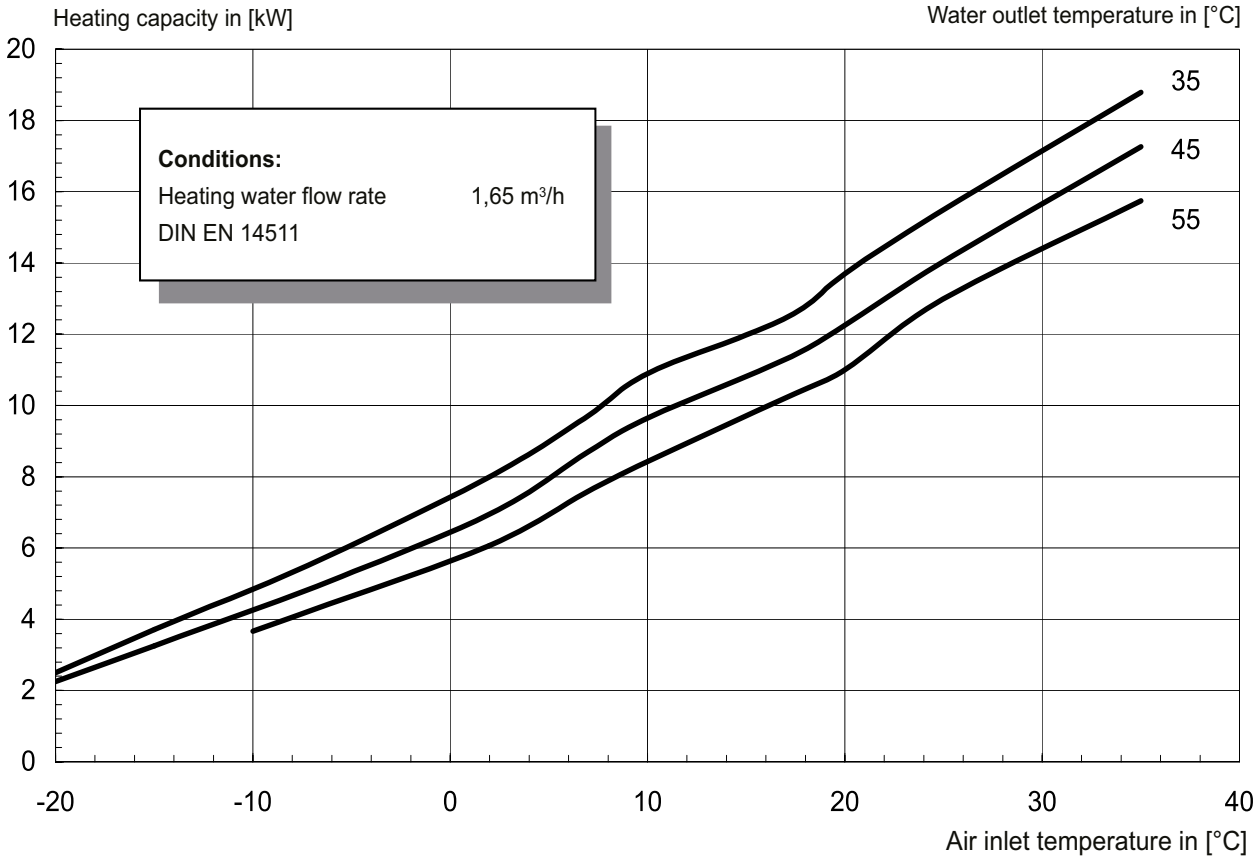
1. For outside air between –20 °C to 0 °C, flow temperature increasing from 49 °C to 58 °C.
2. See output curves
3. This data indicates the size and capacity of the system according to EN14511. For an analysis of the economic and energy efficiency of the system, other parameters, in particular the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values have the following meaning, e.g. A7 / W35: External air temperature 7 °C and heating water flow temperature 35 °C.
4. The electrical connection for the heating element requires its own mains cable with separate fuse.
5. See CE declaration of conformity
6. The heat circulating pump and the heat pump controller must always be ready for operation.

4.3 Reversible Air-to-Water Heat Pumps for Outdoor Installation, three-phase

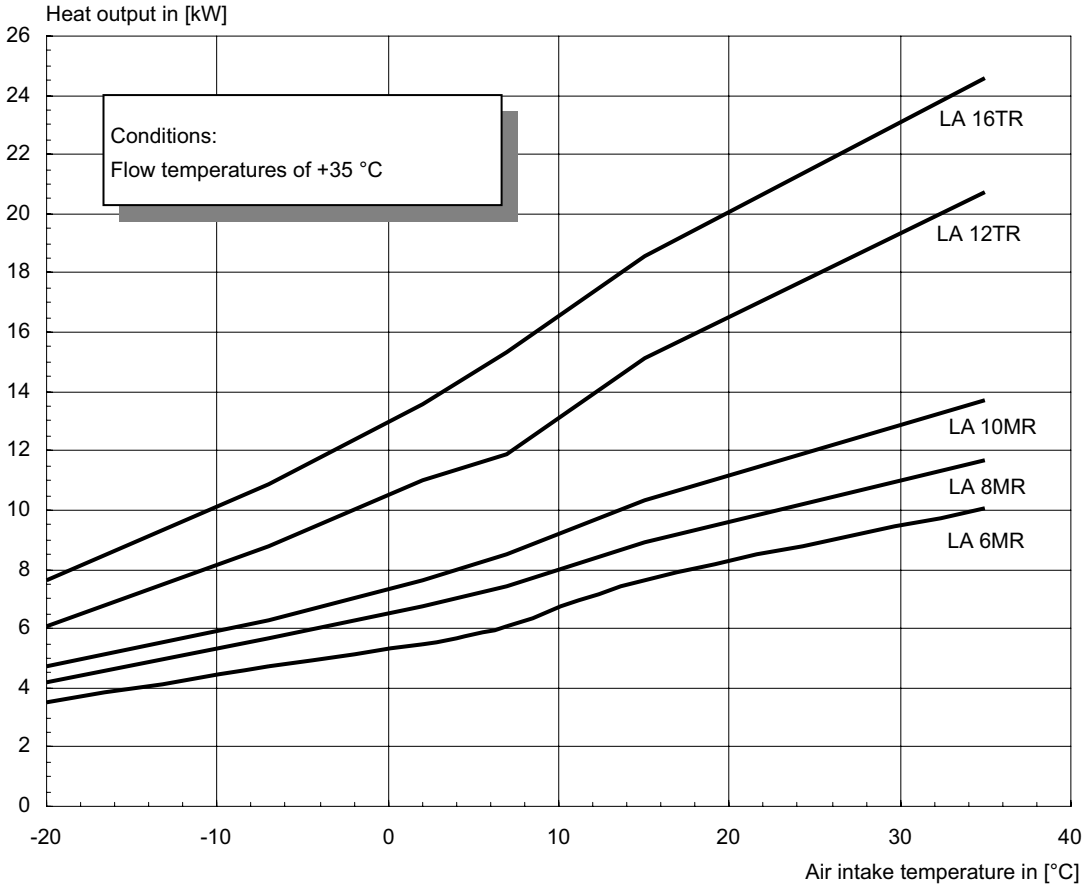
Device information for air-to-water heat pumps for heating purposes					
1	**Type and order code**			LA 12TR	LA 16TR
2	**Design**				
2.1	**Design**			Reversible	Reversible
2.2	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP24	IP24
2.3	**Installation location**			Outdoors	Outdoors
3	**Performance data**				
3.1	**Operating temperature limits:**				
	Heating water flow/return flow		**°C / °C**	up to 60 / above 18	up to 60 / above 18
	Cooling, flow[1]		**°C**	+7 to +20	+7 to +20
	Air (heating)		**°C**	-20 to +35	-20 to +35
	Air (cooling)[1]		**°C**	+15 to +40	+15 to +40
3.2	**Heat output / COP**	**at A7 / W35 [2]**	**kW / ---**	11,9 / 3,3	15,3 / 3,3
		at A7 / W45 [2]	**kW / ---**	11,6 / 2,7	14,9 / 2,8
3.3	**Cooling capacity / COP**	**at A35 / W18**	**kW / ---**	15,8 / 3,3	18,5 / 3,3
		at A35 / W7	**kW / ---**	13,6 / 3,0	16,1 / 3,0
3.4	**Sound power level**	**dB(A)**		72,0	72,0
3.5	**Sound pressure level at a distance of 10 m (air outlet side) dB(A)**			47,0	47,0
3.6	**Heating water flow**		**m³/h**	1,7	1,9
3.7	**Free compression of heat circulating pump (max. level)**		**Pa**	32700	58900
3.8	**Refrigerant; total filling weight**		**type / kg**	R407C / 3.4	R407C / 3.5
3.9	**Max. output of electric heating element (2nd heat generator)**		**kW**	6	6
4	**Dimensions, connections and weight**				
4.1	**Device dimensions**		**H x W x L cm**	86 x 127 x 67	86 x 127 x 67
4.2	**Device connections to heating system**		**Inch**	Thread 1" external	Thread 1" external
4.3	**Weight of the transportable unit(s) incl. Packing**		**kg**	185	196
5	**Electrical Connection**				
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 20	400 / 25
5.2	**Heat element fuse (230 V devices only)**		**A**	-	-
5.3	**Nominal power consumption [2]**	**A2 W35**	**kW**	3,6	4,6
5.4	**Starting current with soft starter**		**A**	26	27
5.5	**Nominal current A2 W35 / cosφ**		**A / ---**	6.5	8,3
6	**Complies with the European safety regulations**			[4]	[4]
7	**Additional model features**				
7.1	**Defrosting**			Automatic	Automatic
	Type of defrosting			Reverse circulation	Reverse circulation
	Defrosting tray included			Yes (heated)	Yes (heated)
7.2	**Heating water in device protected against freezing**			Yes [5]	Yes [5]
7.3	**Performance levels**			1	1

1. See operating limits diagram
2. This data indicates the size and capacity of the system. For an analysis of the economic and energy efficiency of the system, other parameters, such as, in particular, defrosting capacity, bivalence point and regulation, should also be taken into consideration. The specified values have the following meaning, e.g. A7 / W35: external air temperature 7 °C and heating water flow temperature 35 °C.

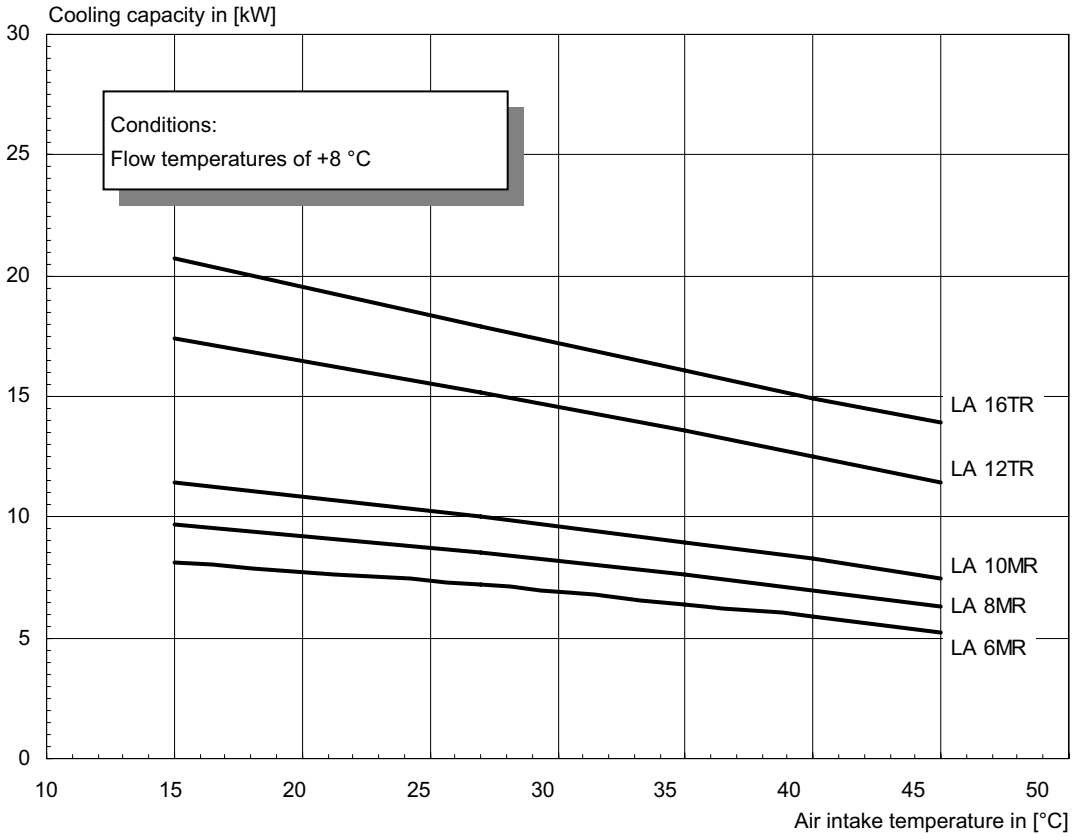
4.4 Characteristic Curve LAK 10M (Heating Operation)



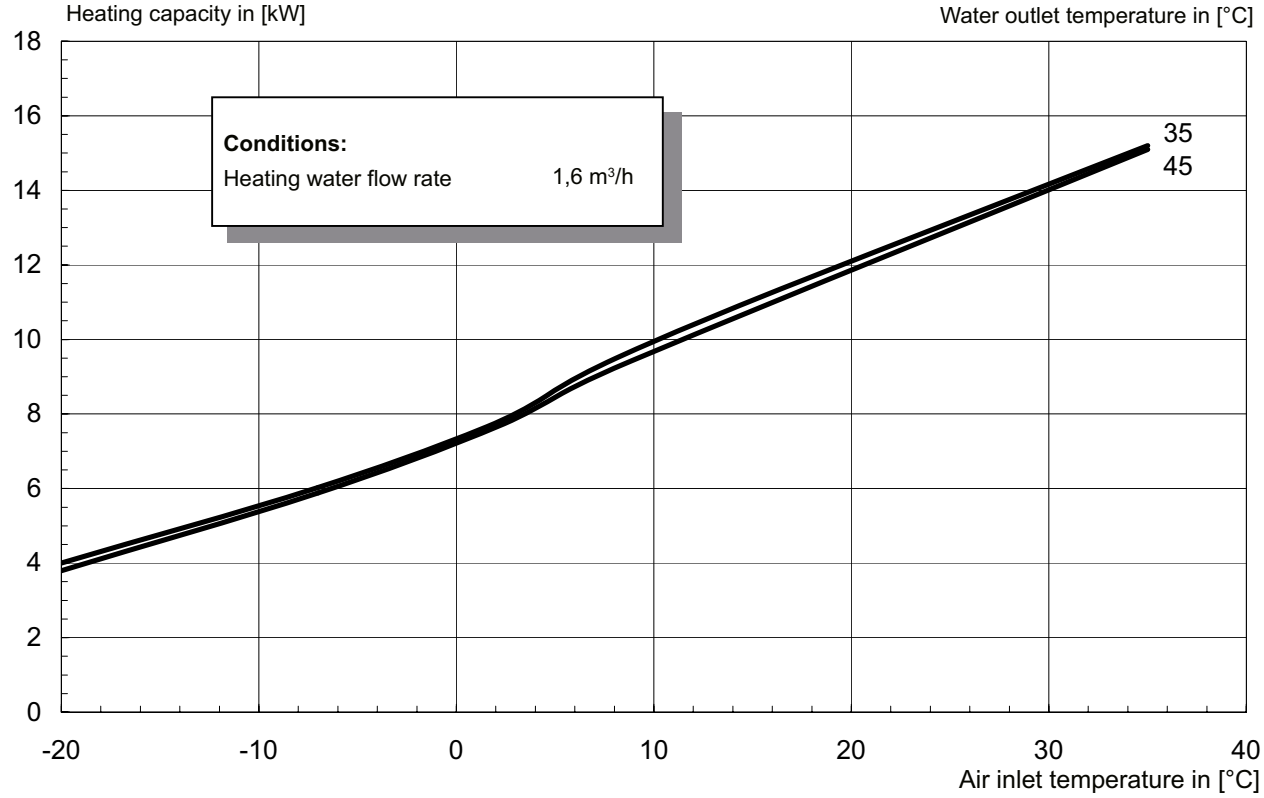
4.5 Characteristic Curves LA 6/8/10MR and LA 12/16TR (Heating Operation)



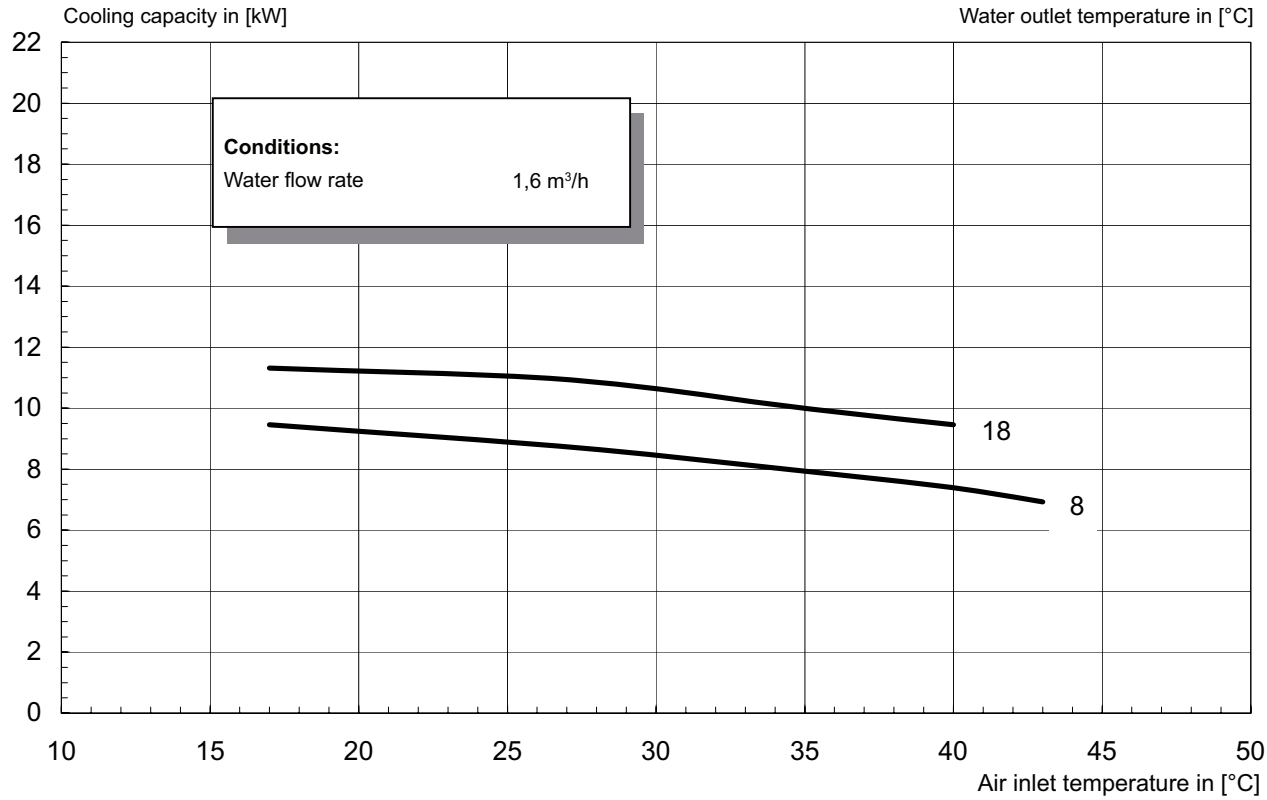
4.6 Characteristic Curves LA 6/8/10MR and LA 12/16TR (Cooling Operation)



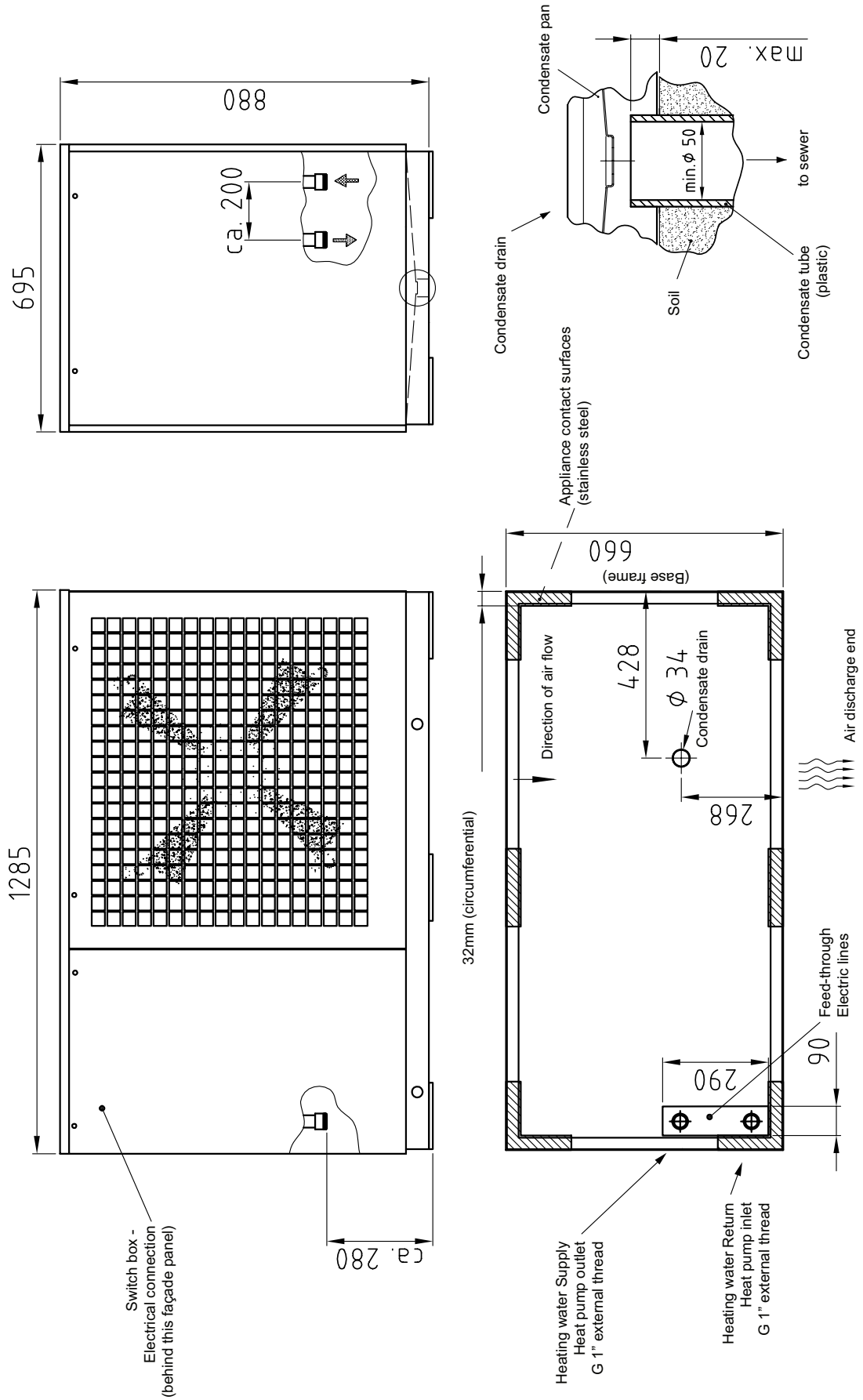
4.7 Characteristic Curves LAK 10MR (Heating Operation)



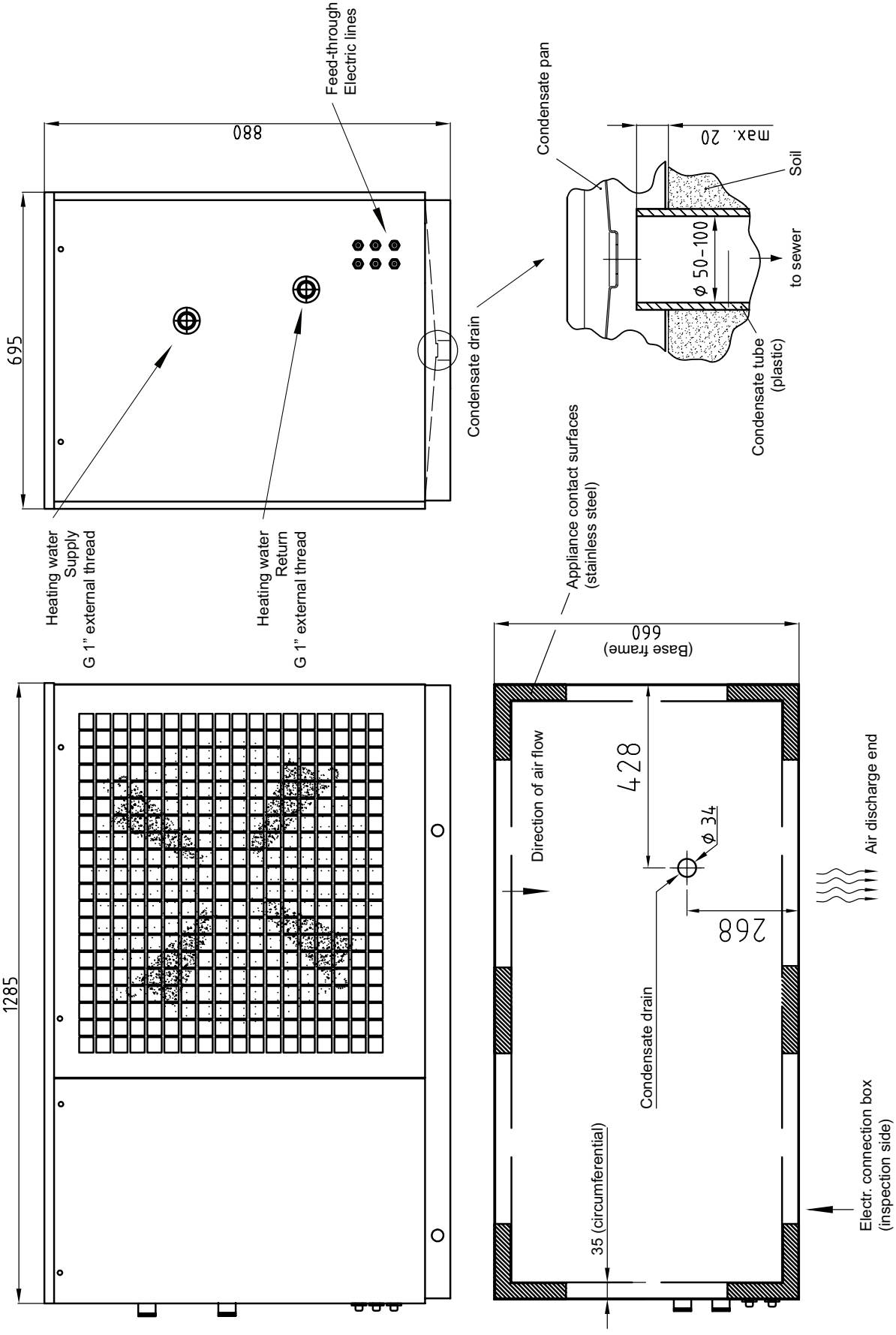
4.8 Characteristic Curves LAK 10MR (Cooling Operation)



4.9 Dimensions LAK 10M



4.10 Dimensions LA 6/8/10MR and LA 12/16TR



5 Device Information for Brine-to-Water Heat Pumps with Simplified Regulation

5.1 Reversible brine-to-water heat pumps for indoor installation, single-phase

Device information for brine-to-water heat pumps for heating purposes					
1	**Type and order code**			SI 8MR	SI 10MR
2	**Design**				
2.1	**Design**			Reversible	Reversible
2.2	**Degree of protection according to EN 60 529**			IP20	IP20
2.3	**Installation location**			Indoors	Indoors
3	**Performance data**				
3.1	**Operating temperature limits:**				
	Heating water flow		**°C**	Up to 60	Up to 60
	Cooling, flow		**°C**	+7 to +20	+7 to +20
	Brine (heat source, heating)		**°C**	-5 to +25	-5 to +25
	Brine (heat sink, cooling)		**°C**	+5 to +25	+5 to +25
	Antifreeze			Monoethylene glycol	Monoethylene glycol
	Minimum brine concentration (-13 °C freezing temperature)			25%	25%
3.2	**Temperature spread of heating water (flow/return flow) at B0 / W35K**			10.6	9.9
3.3	**Heat output / COP**	**at B-5 / W55** [1]	**kW / ---**	7,5 / 2,0	9,8 / 2,1
		at B0 / W50 [1]	**kW / ---**	8,8 / 2,8	11,3 / 2,9
		at B0 / W35 [1]	**kW / ---**	9,3 / 4,0	11,6 / 4,1
3.4	**Cooling capacity / COP**	**at B20 / W8**	**kW / ---**	9,9 / 4,6	11,4 / 4,6
		at B20 / W18	**kW / ---**	12,0 / 54	14,1 / 5,3
		at B10 / W8	**kW / ---**	9,9 / 5,6	11,6 / 5,7
		at B10 / W18	**kW / ---**	12,4 / 6,7	14,1 / 6,5
3.5	**Sound power level**		**dB(A)**	54	55
3.6	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**	0,75/ 2300	1,0 / 4100
3.7	**Brine flow with an internal pressure differential (heat source) of**		**m³/h / Pa**	2,3 / 25000	3,0 / 24000
3.8	**Refrigerant; total filling weight**		**type / kg**	R407C / 1.3	R407C / 1.5
4	**Dimensions, connections and weight**				
4.1	**Device dimensions without connections** [2]		**H x W x L mm**	1220 x 640 x 624	1220 x 640 x 624
4.2	**Device connections to heating system**		**Inch**	G 1" external	G 1" external
4.3	**Device connections to heat source**		**Inch**	G 1" external	G 1" external
4.4	**Weight of the transportable unit(s) incl. Packing**		**kg**	162	163
5	**Electrical Connection**				
5.1	**Nominal voltage; fuse protection**		**V / A**	230 / 20	230 / 25
5.2	**Nominal power consumption** [1]	**B0 W35**	**kW**	2.3	2.8
5.3	**Starting current with soft starter**		**A**	38	38
5.4	**Nominal current B0 W35 / cos φ**		**A / ---**	12,5 / 0,8	15,2 / 0,8
6	**Complies with the European safety regulations**			[3]	[3]
7	**Additional model features**				
7.1	**Water in device protected against freezing** [4]			No	No
7.2	**Performance levels**			1	1
7.3	**Regulator internal/external**			Internal	Internal

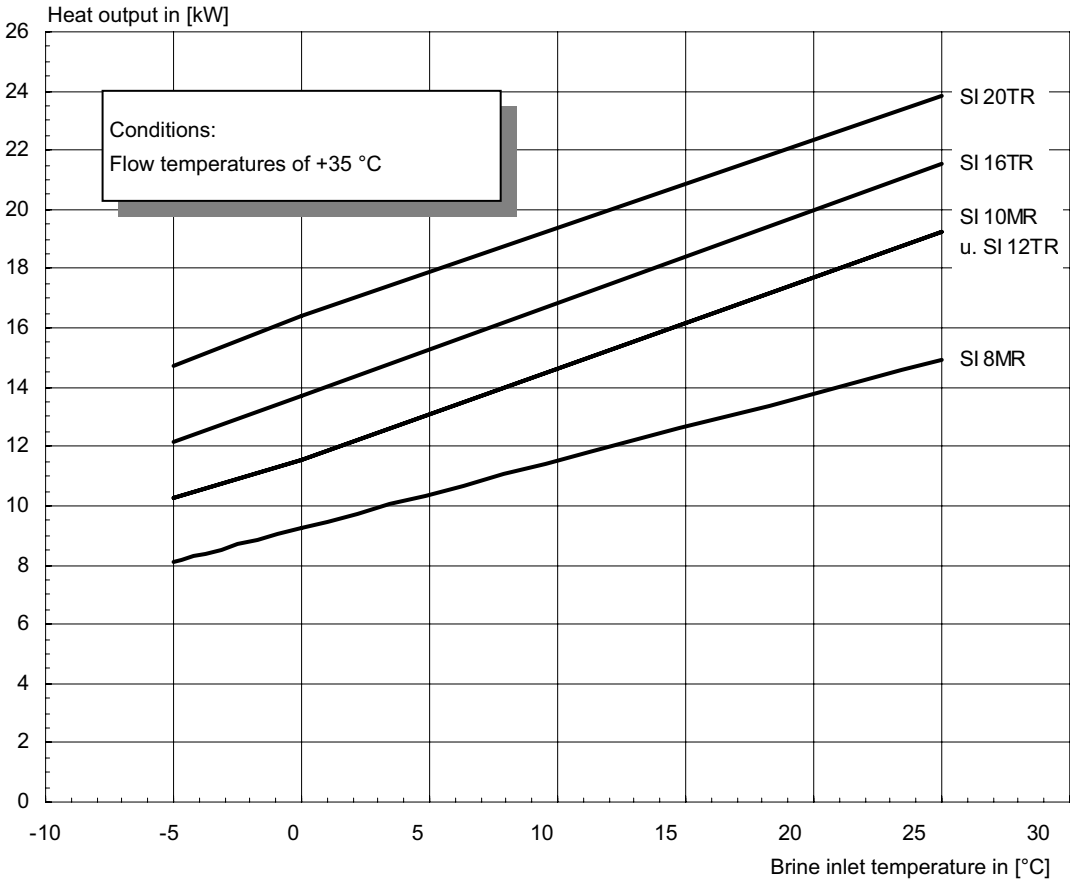
1. This data indicates the size and capacity of the system. For an analysis of the economic and energy efficiency of the system, both the bivalence point and the regulation should also be taken into consideration. The specified values, e.g. B10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Note that additional space is required for pipe connections, operation and maintenance.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

5.2 Reversible brine-to-water heat pumps for indoor installation, three-phase

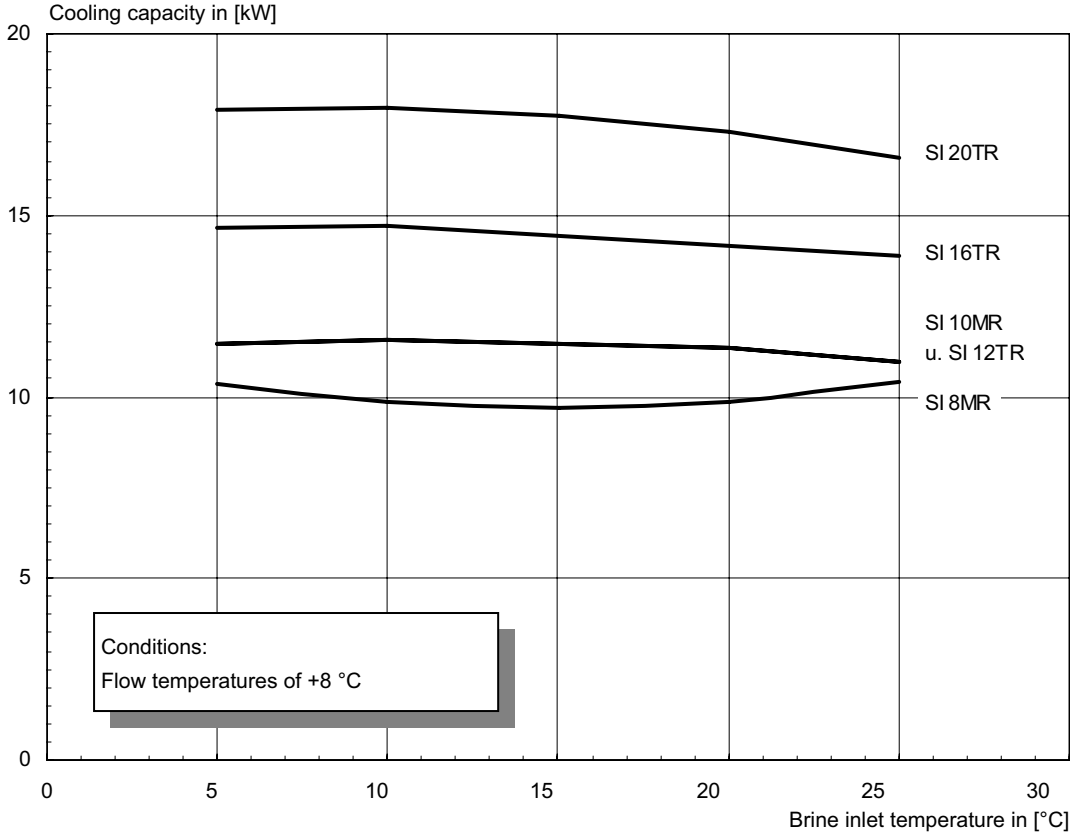
Device information for brine-to-water heat pumps for heating purposes							
1	**Type and order code**			SI 12TR	SI 14TR	SI 16TR	SI 20TR
2	**Design**						
2.1	**Design**			Reversible	Reversible	Reversible	Reversible
2.2	**Degree of protection according to EN 60 529**			IP20	IP20	IP20	IP20
2.3	**Installation location**			Indoors	Indoors	Indoors	Indoors
3	**Performance data**						
3.1	**Operating temperature limits:**						
	Heating water flow		**°C**	Up to 60	Up to 60	Up to 60	Up to 60
	Cooling, flow		**°C**	+7 to +20	+7 to +20	+7 to +20	+7 to +20
	Brine (heat source, heating)		**°C**	-5 to +25	-5 to +25	-5 to +25	-5 to +25
	Brine (heat sink, cooling)		**°C**	+5 to +25	+5 to +25	+5 to +25	+5 to +25
	Antifreeze			Monoethylene glycol	Monoethylene glycol	Monoethylene glycol	Monoethylene glycol
	Minimum brine concentration (-13 °C freezing temperature)			25%	25%	25%	25%
3.2	**Temperature spread of heating water (flow/return flow) at B0 / W35K**			9.9	9.4	9.6	10.7
3.3	**Heat output / COP**	**at B-5 / W55** [1]	**kW / ---**	9,8 / 2,1	12,2 / 2,3	14,1 / 2,4	18,7 /2,5
		at B0 / W50 [1]	**kW / ---**	11,3 / 2,9	13,5 / 2,9	16,3 / 3,2	20,4 / 3,1
		at B0 / W35 [1]	**kW / ---**	11,6 / 4,1	13,7 / 4,0	16,4 / 4,0	20,0 / 4,2
3.4	**Cooling capacity / COP**	**at B20 / W8**	**kW / ---**	11,4 / 4,6	14,1 / 5,0	17,3 / 4,9	21,5 / 4,9
		at B20 / W18	**kW / ---**	14,1 / 5,3	17,4 / 5,9	21,5 / 5,9	26,0 / 5,7
		at B10 / W8	**kW / ---**	11,6 / 5,7	14,7 / 6,4	18,0 / 6,4	21,9 / 5,9
		at B10 / W18	**kW / ---**	14,1 / 6,5	17,4 / 7,1	21,5 / 7,3	27,7 / 7,1
3.5	**Sound power level**		**dB(A)**	56	56	56	56
3.6	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**	1,0 / 4100	1,3 / 4850	1,5 / 4000	1,6 / 3400
3.7	**Brine flow with an internal pressure differential (heat source) of**		**m³/h / Pa**	3,0 / 24000	3,5 / 17900	3,8 / 18400	3,5 / 13900
3.8	**Refrigerant; total filling weight**		**type / kg**	R407C / 1.4	R407C / 2.1	R407C / 2.4	R407C / 3.2
4	**Dimensions, connections and weight**						
4.1	**Device dimensions without connections** [2]		**H x W x L mm**	1220 x 640 x 624	1220 x 640 x 624	1220 x 640 x 624	1220 x 640 x 624
4.2	**Device connections to heating system**		**Inch**	G 1" external	G 1" external	G 1" external	G 1" external
4.3	**Device connections to heat source**		**Inch**	G 1" external	G 1" external	G 1¼" external	G 1¼" external
4.4	**Weight of the transportable unit(s) incl. Packing**		**kg**	164	166	172	237
5	**Electrical Connection**						
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 16	400 / 16	400 / 16	400 / 16
5.2	**Nominal power consumption** [1]	**B0 W35**	**kW**	2.8	3.41	4.1	4.8
5.3	**Starting current with soft starter**		**A**	26	26	30	30
5.4	**Nominal current B0 W35 / cos φ**		**A / ---**	4,8 / 0,8	6,2 / 0,8	7,4 / 0,8	11,0 / 0,8
6	**Complies with the European safety regulations**			[3]	[3]	[3]	[3]
7	**Additional model features**						
7.1	**Water in device protected against freezing** [3]			No	No	No	No
7.2	**Performance levels**			1	1	1	1
7.3	**Regulator internal/external**			Internal	Internal	Internal	Internal

1. This data indicates the size and capacity of the system. For an analysis of the economic and energy efficiency of the system, both the bivalence point and the regulation should also be taken into consideration. The specified values, e.g. B10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Note that additional space is required for pipe connections, operation and maintenance.
3. The heat circulating pump and the heat pump controller must always be ready for operation.

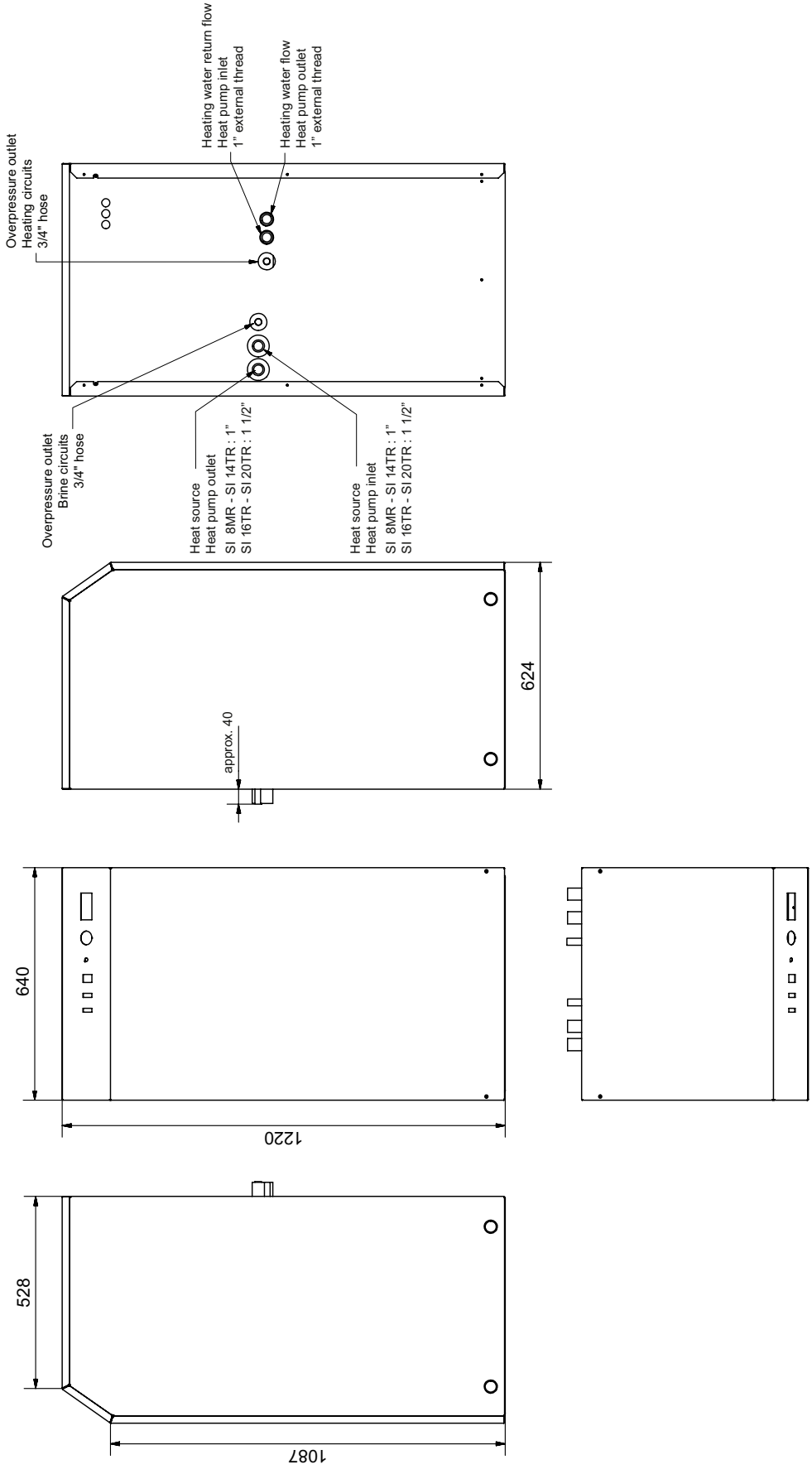
5.3 Characteristic Curves SI 8/10MR and SI 12/14/16/20TR (Heating Operation)



5.4 Characteristic Curves SI 8/10MR and SI 12/14/16/20TR (Cooling Operation)



5.5 Dimensions SI 8/10MR and SI 12/14/16/20TR



6 Electrical Installation

6.1 Power supply

Depending on the technical data of the device, the power supply of the heat pump is 230VAC/50Hz or 3-L/NPE 400VAC.

A standard 3-core cable is used for single-phase devices (230 V AC). A 3-core cable is used as load connection for the heat pump (terminal strip X3) and the electrical supplementary heating (2nd heat generator) for air-to-water heat pumps is connected with a second 3-core cable. Depending on the required output of the supplementary heating, the bridges A7.1 for 4 kW and A7.2 for 6 kW must still be put in place.

A standard 5-core cable must be used for 3-phase devices (400 V AC) for the load connection (terminal strip X1). For air-to-water heat pumps, the electrical supplementary heating (2nd heat generator) is also supplied via this load connection. If the entire 6 kW output of the supplementary heating is not needed, the respective contacts between K20 and B5/F17 can be interrupted.

⚠ ATTENTION!

According to the respective regulations typical in a given country, a disconnecting device with a contact gap of at least 3 mm (e.g. utility blocking contactor or power contactor) as well as a 1-pole circuit breaker must be installed in the power supply of the heat pump (tripping current in compliance with the device information).

i NOTE

Ensure that there is a clockwise rotating field (for multiphase devices): Operating the compressor in the wrong rotational direction could cause damage to the compressor. Incorrect phase sequence causes wrong rotational direction of the ventilator and, thus, a significantly reduced performance.

6.2 Connection of remote controller (only air-to-water heat pumps)

The control voltage for the remote controller is primarily 230 V AC (except for N10/8/8) and is ensured by the heat pump. The connecting cable (control line) from the remote control to the heat pump must be provided externally and must be suitable for a 230 V AC supply voltage. The cable must have at least 6 cores with a single-core cross section of at least 0.5 mm². The individual outputs (remote controller N10) and inputs (heat pump X2) must be connected according to the circuit diagram.

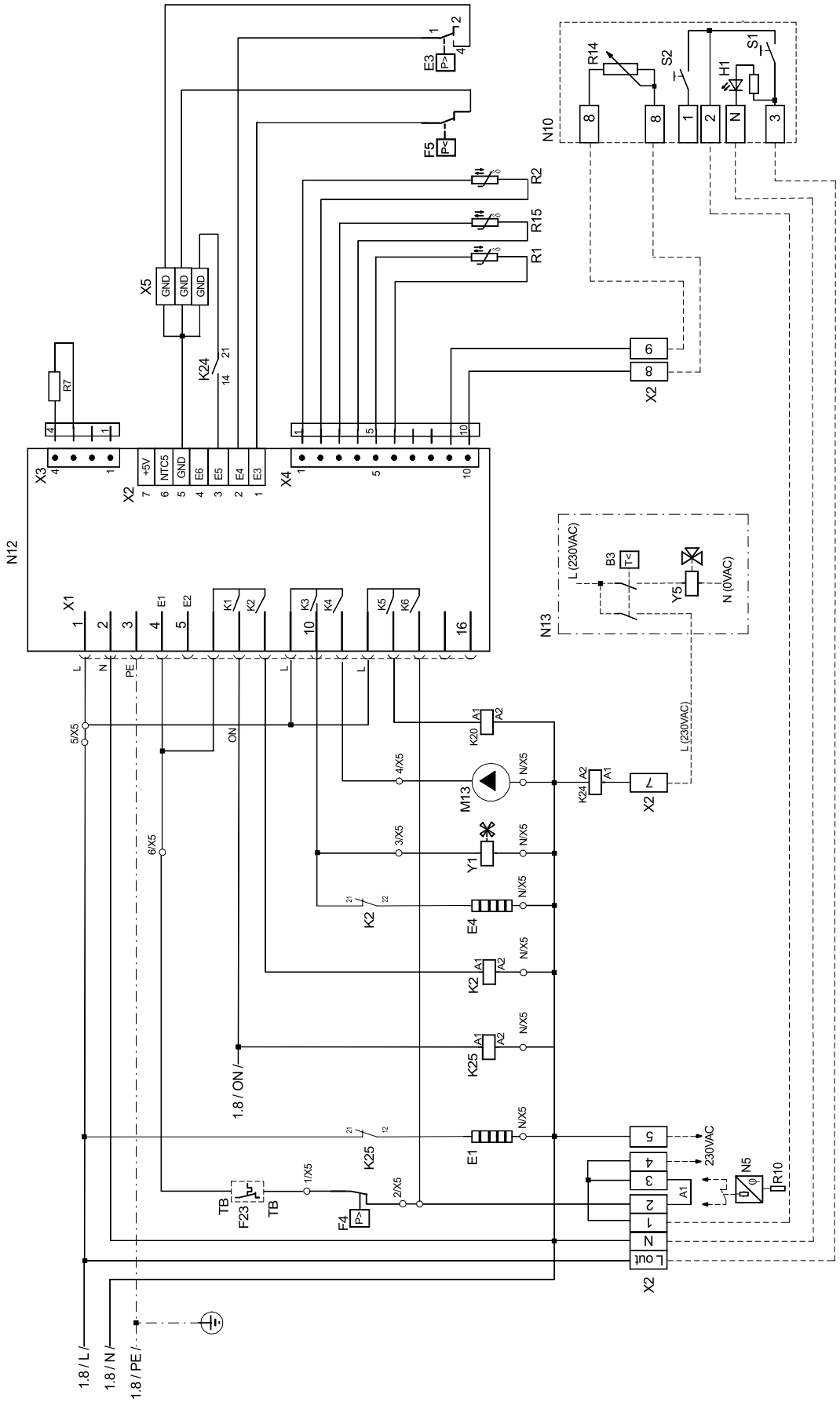
6.3 Hot water preparation connection

The hot water preparation consists of a thermostat in the warm water cylinder and a 3-way reversing valve. These components are to be combined in the hot water switching assembly as N13 in the circuit diagrams and switched accordingly. The 230 V AC power supply of this switching assembly has to be done as shown in the circuit diagrams. The output, i.e. the signal, of this switching assembly is then connected to the terminal strip X2/7.

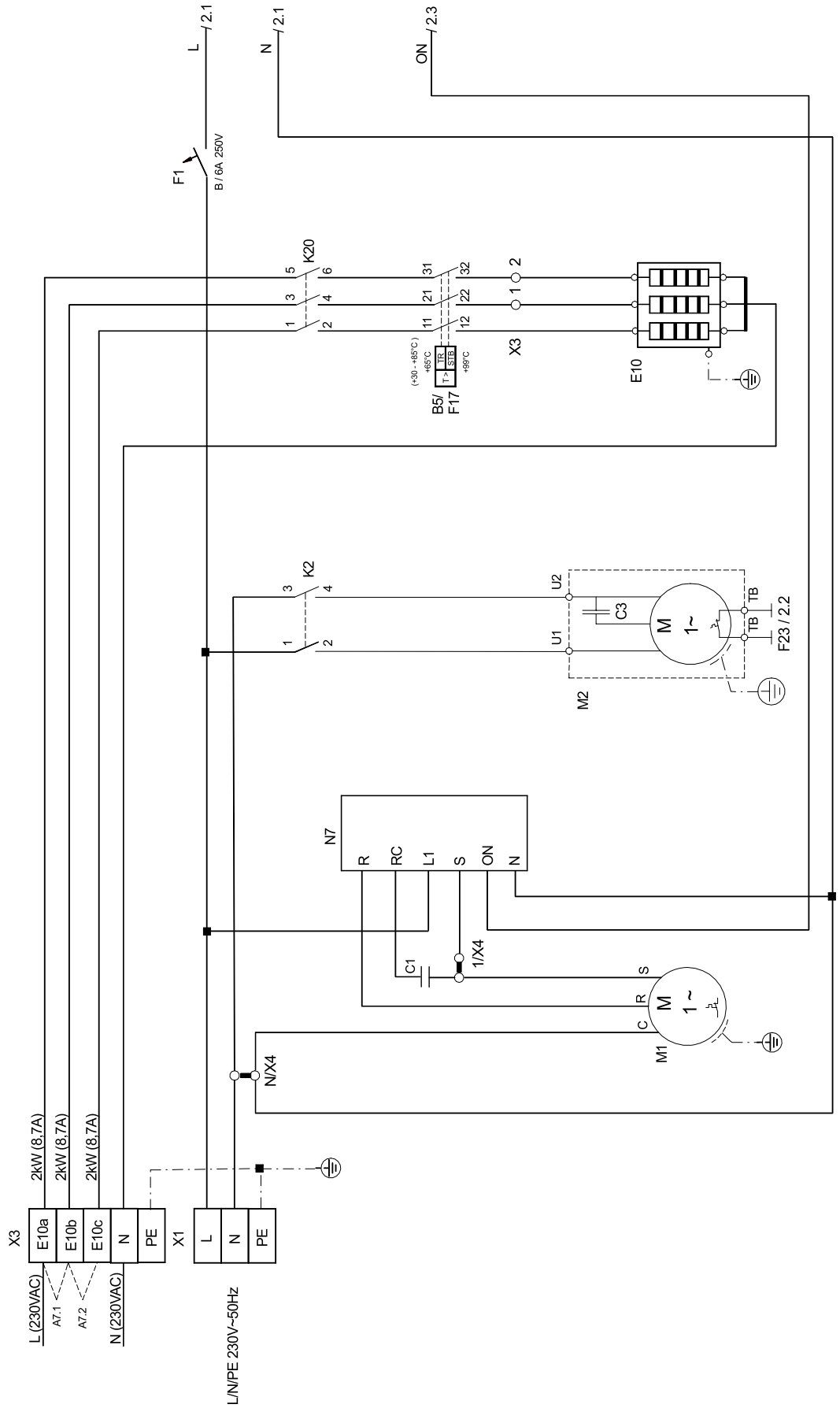
6.4 Dew point monitoring connection

See accessories "7.5.2 Dew Point Monitoring in Cooling Operation"

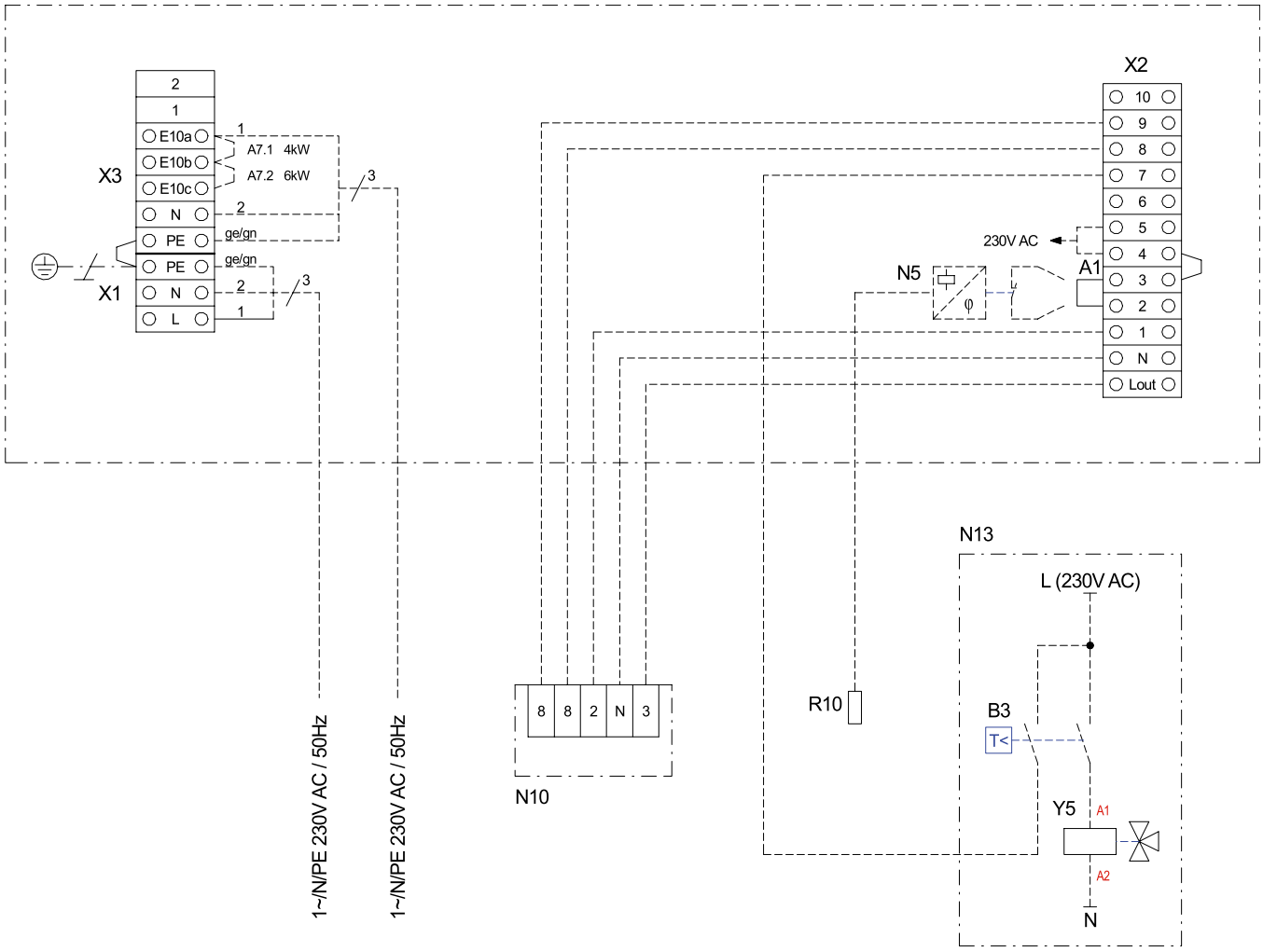
6.5 Control LAK 10M, LAK 10MR



6.6 Load LAK 10M, LAK 10MR



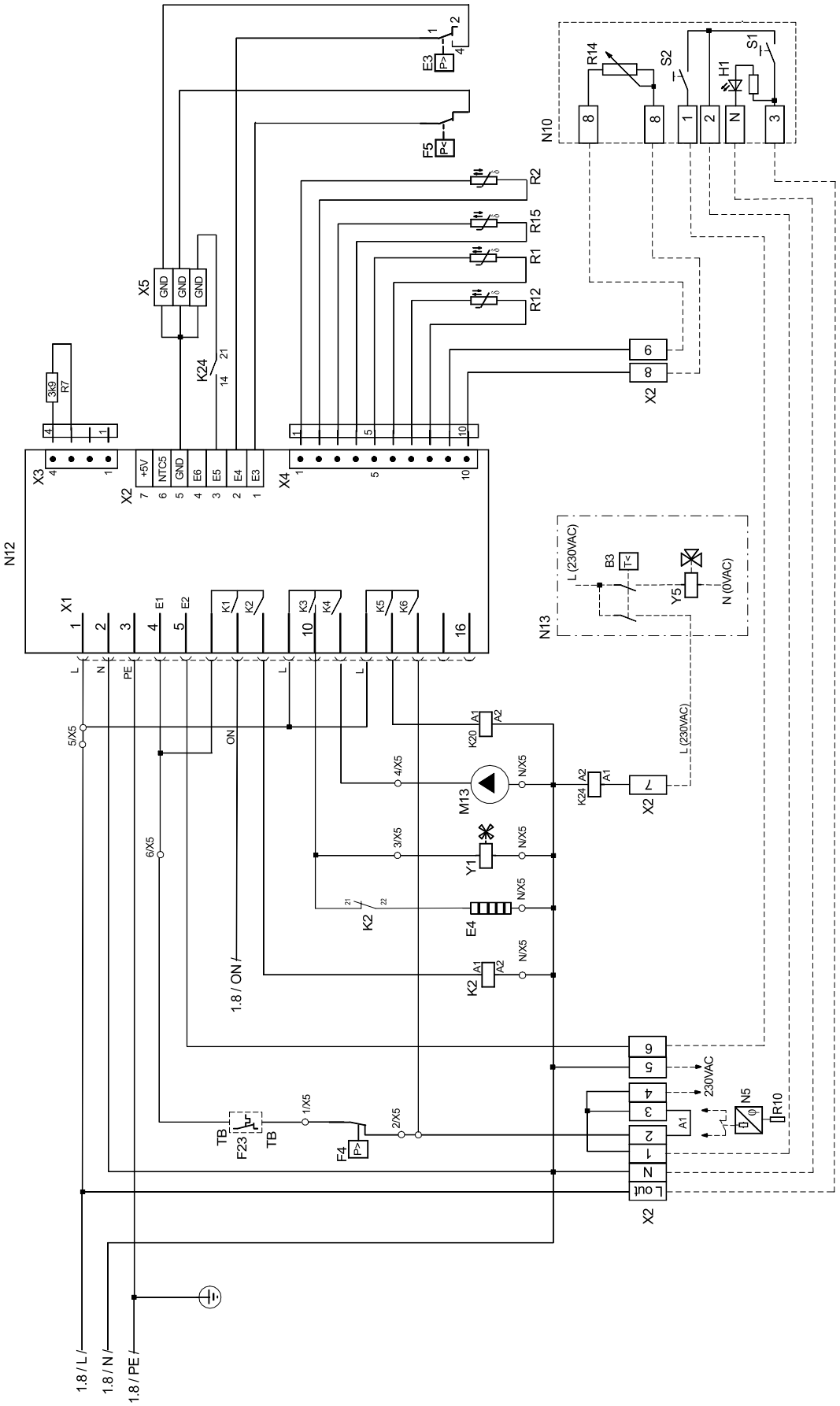
6.7 Circuit diagram LAK 10M, LAK 10MR



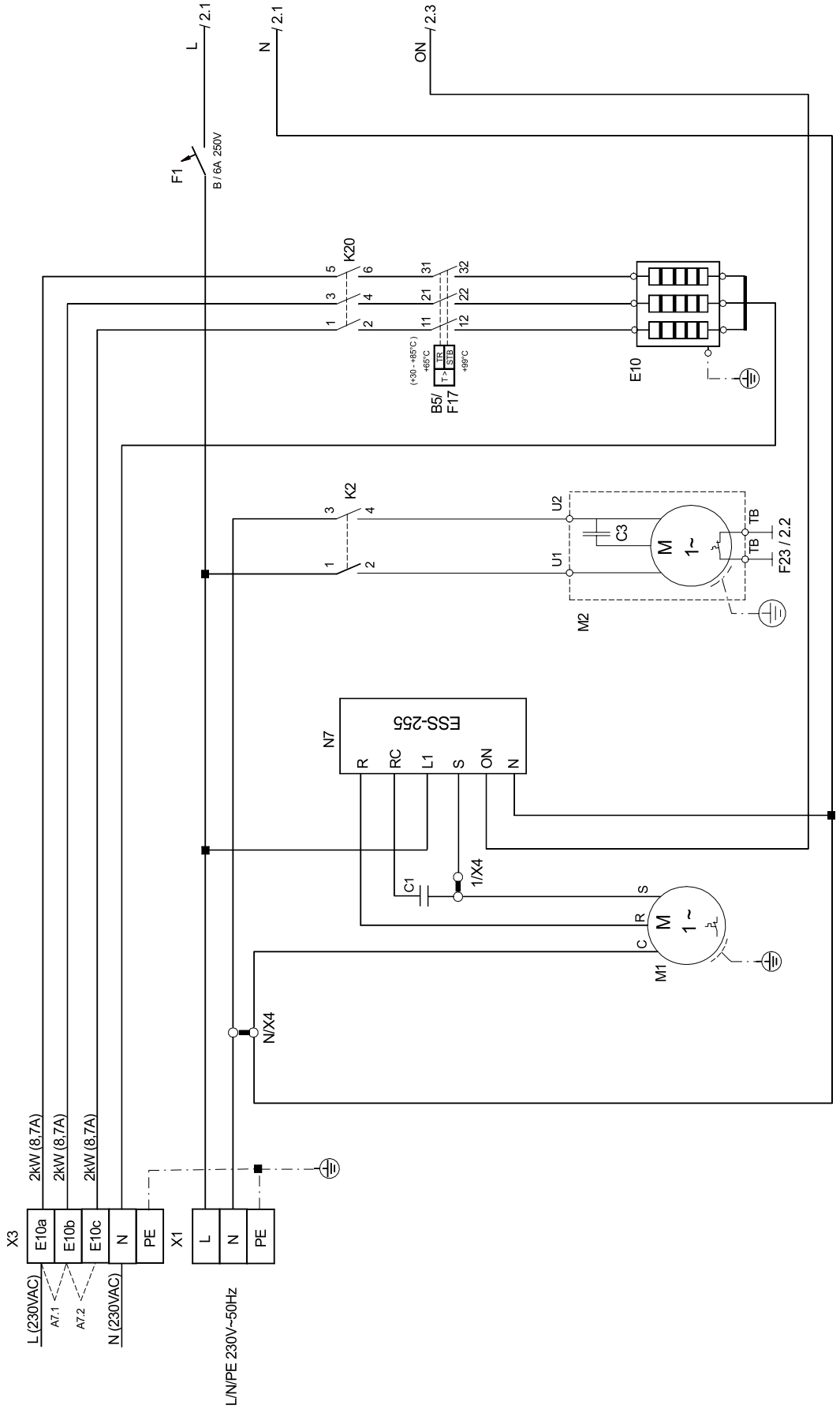
6.8 Legend LAK 10M, LAK 10MR

A1	Wire jumper: The jumper must be removed for external control (via floating contact) or the use of a dew point monitor (via floating contact).
A7.1	4 kW bridge - 2nd heat generator
A7.2	6 kW bridge - 2nd heat generator
B3*	Hot water thermostat
B5	Control thermostat for supplementary heating
C1	Operating condenser - compressor
C3	Operating condenser, ventilator
E1	Crankcase heater, compressor
E3	Defrost end controller
E4	Nozzle ring heater
E10	2. Heat generator (no bridge = 2 kW; only A7.1 = 4 kW; A7.1 + A7.2 = 6 kW)
F1	Control fuse
F4	High-pressure switch
F5	Low-pressure switch
F17	Safety temperature limiter - 2nd heat generator
F23	Thermal contact for ventilator
H1**	Indicator lamp, ready for operation
K2	Contactor, ventilator
K20	Contactor for 2nd heat generator
K24	Relay for hot water request
K25	Relay compressor
M1	Compressor
M2	Ventilator
M13	Heat circulating pump
N5*	Dew point monitor
N7	Soft starter
N10	Remote control
N12	Control PCB
N13*	Switching assembly, hot water
R1	External sensor
R2	Return flow sensor
R7	Coding resistor 3.9 kOhm
R10*	Humidity sensor
R14**	Setpoint potentiometer
R15	Flow sensor
S1**	Control switch HP ON/OFF
S2**	Not used
X1	Terminal strip for mains L/N/PE - 230 V AC / 50 Hz
X2	Terminal strip for external components
X3	Terminal strip - 2nd heat generator
X4	Terminal strip for compressor
X5	Terminal strip for internal wiring
Y1	Four-way reversing valve, heating/cooling
Y5*	Three-way reversing valve for DHW preparation
*	Components to be supplied from external sources
**	Components are in the remote control
———	Wired ready for use
- - - - - -	To be connected on site, as required

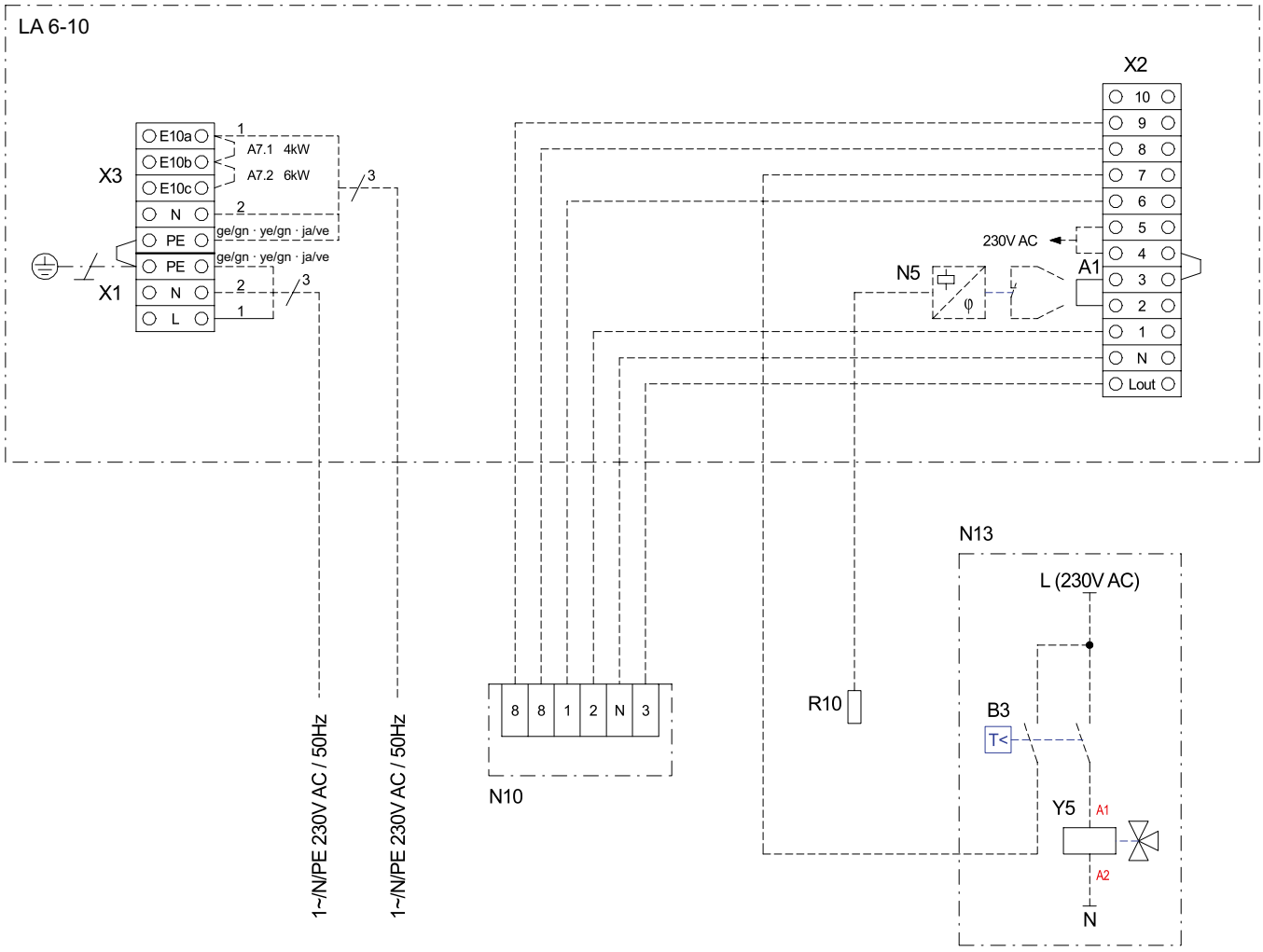
6.9 Control LA 6MR - LA 10MR



6.10 Load LA 6MR - LA 10MR



6.11 Circuit diagram LA 6MR - LA 10MR

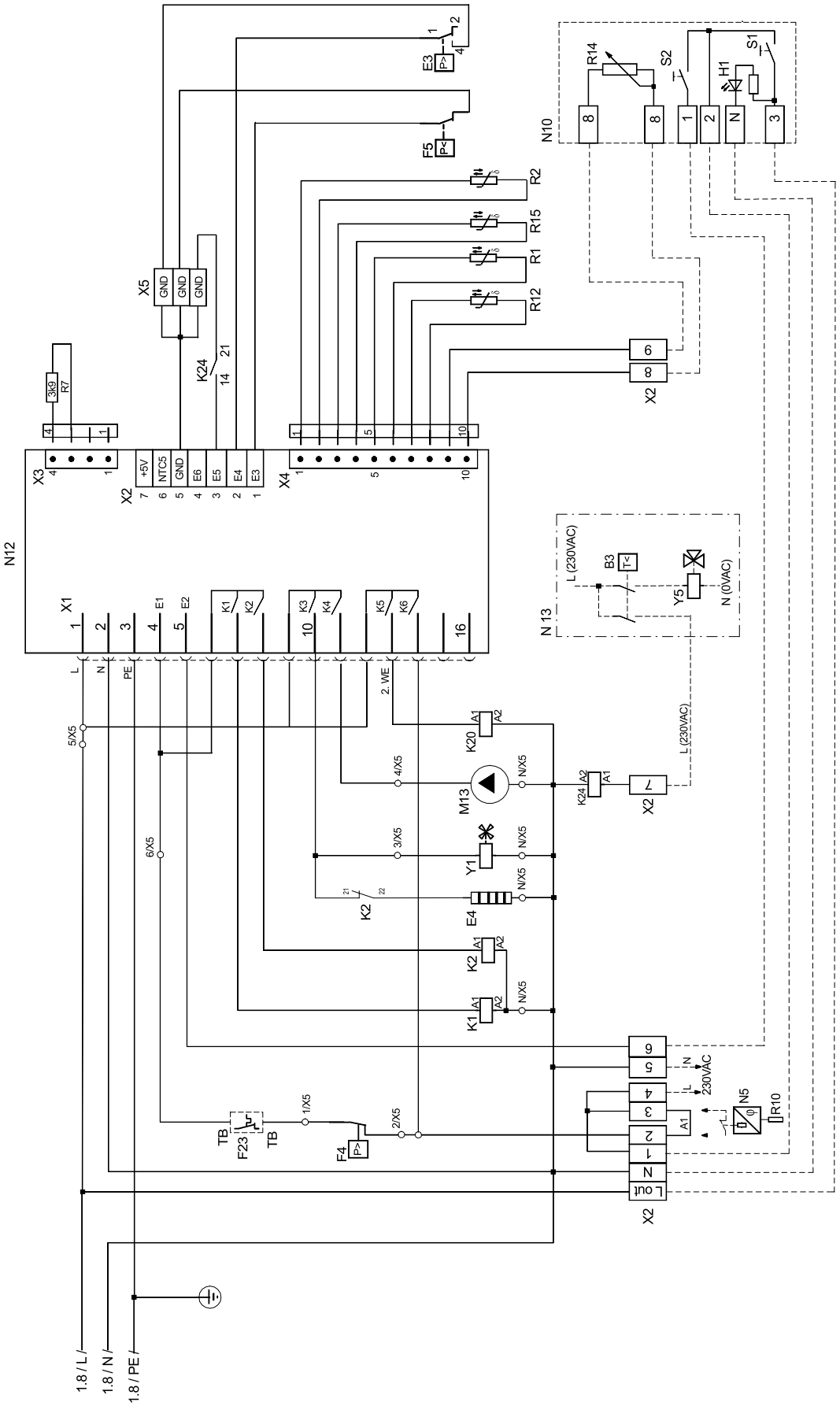


6.12 Legend LA 6MR - LA 10MR

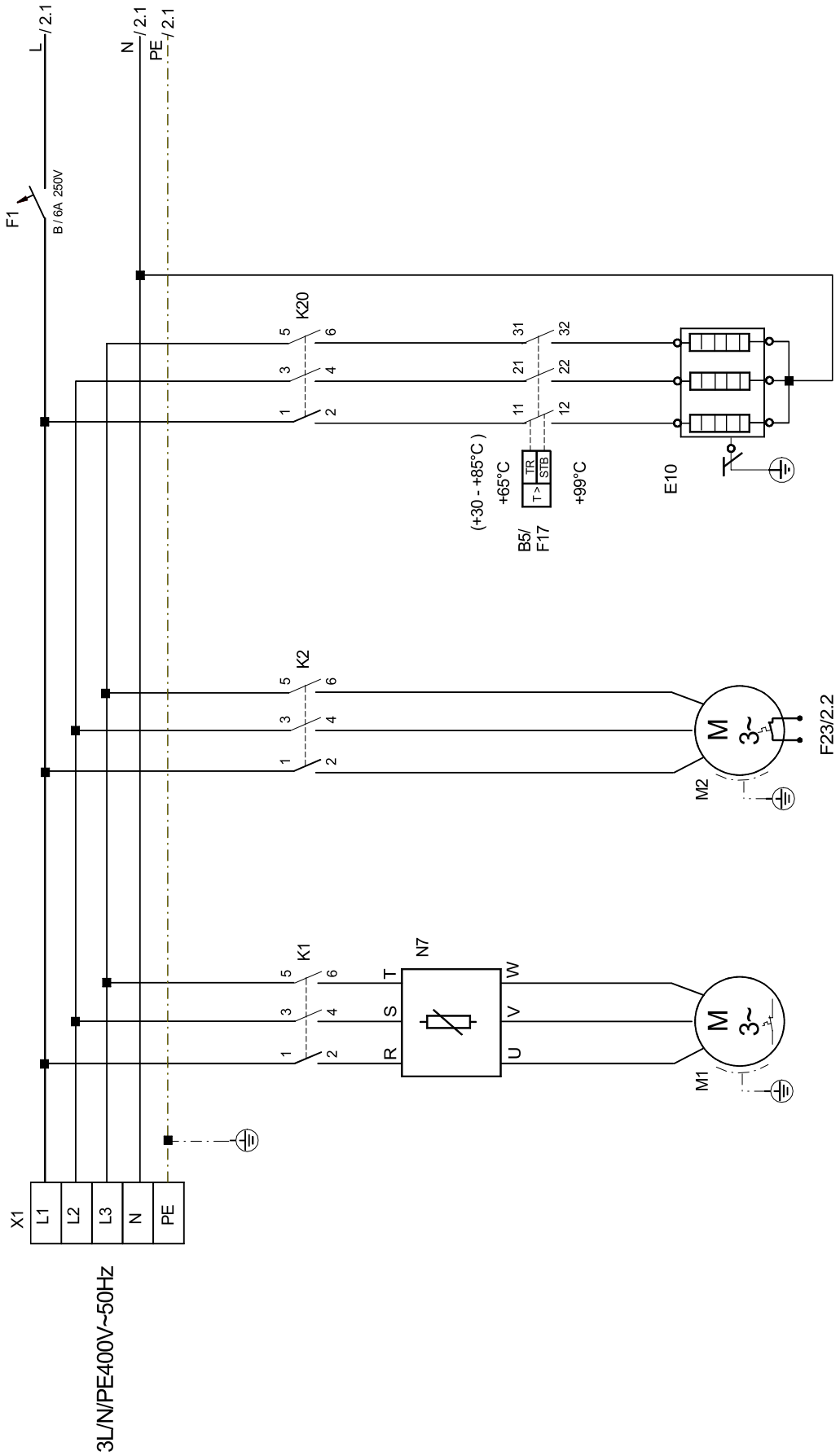
A1	Wire jumper: The jumper must be removed for external control (via floating contact) or the use of a dew point monitor (via floating contact).
A7.1	4 kW bridge - 2nd heat generator
A7.2	6 kW bridge - 2nd heat generator
B3*	Hot water thermostat
B5	Control thermostat for supplementary heating
C1	Operating condenser - compressor
C3	Operating condenser, ventilator
E3	Defrost end controller
E4	Nozzle ring heater
E10	2. Heat generator (no bridge = 2 kW; only A7.1 = 4 kW; A7.1 + A7.2 = 6 kW)
F1	Control fuse
F4	High-pressure switch
F5	Low-pressure switch
F17	Safety temperature limiter - 2nd heat generator
F23	Thermal contact for ventilator
H1**	Indicator lamp, ready for operation
K2	Contactor, ventilator
K20	Contactor for 2nd heat generator
K24	Relay for hot water request
M1	Compressor
M2	Ventilator
M13	Heat circulating pump
N5*	Dew point monitor
N7	Soft starter
N10	Remote control
N12	Control PCB
N13*	Switching assembly, hot water
R1	External sensor
R2	Return flow sensor
R7	Coding resistor
R10*	Humidity sensor
R12	Flow sensor for cooling operation (water)
R14**	Setpoint potentiometer
R15	Flow sensor
S1**	Control switch HP ON/OFF
S2**	Changeover switch HEATING/COOLING
X1	Terminal strip for mains L/N/PE - 230 V AC / 50 Hz
X2	Terminal strip for external components
X3	Terminal strip - 2nd heat generator
X4	Terminal strip for compressor
X5	Terminal strip for internal wiring
Y1	Four-way reversing valve, heating/cooling
Y5*	Three-way reversing valve for DHW preparation

*	Components to be supplied from external sources
**	Components are in the remote control

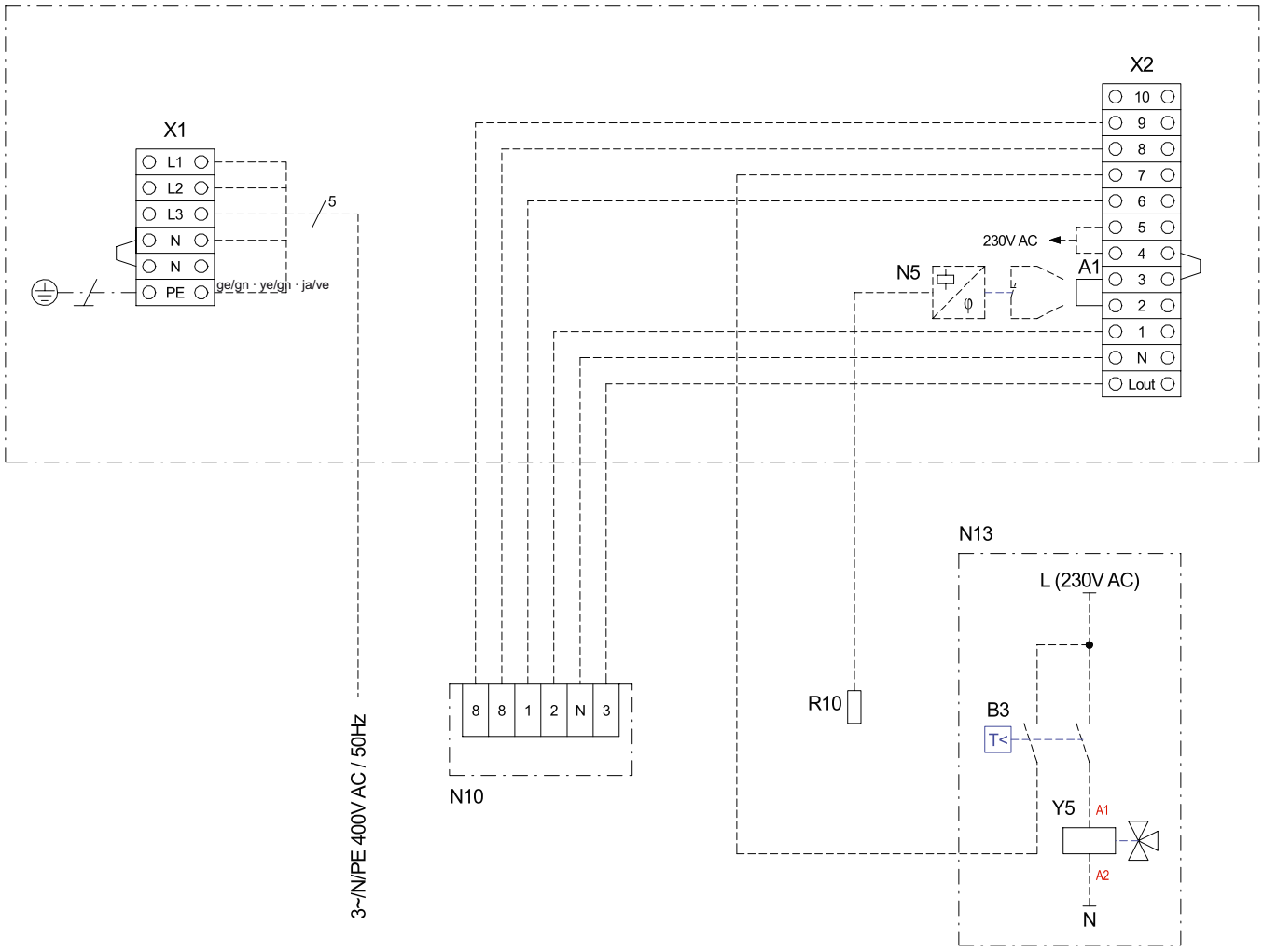
6.13 Control LA 12TR - LA 16TR



6.14 Load LA 12TR - LA 16TR



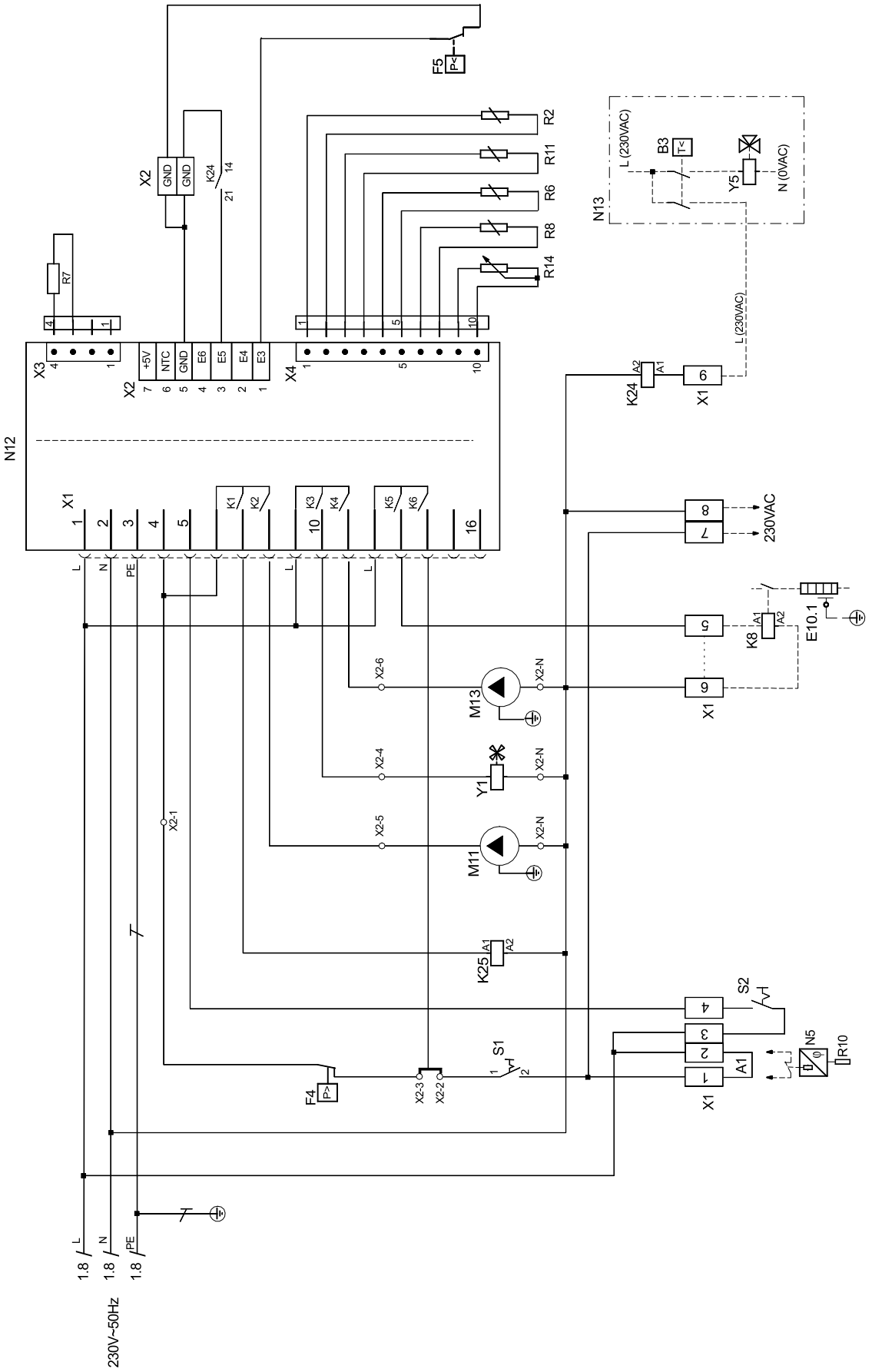
6.15 Circuit diagram LA 12TR - LA 16TR



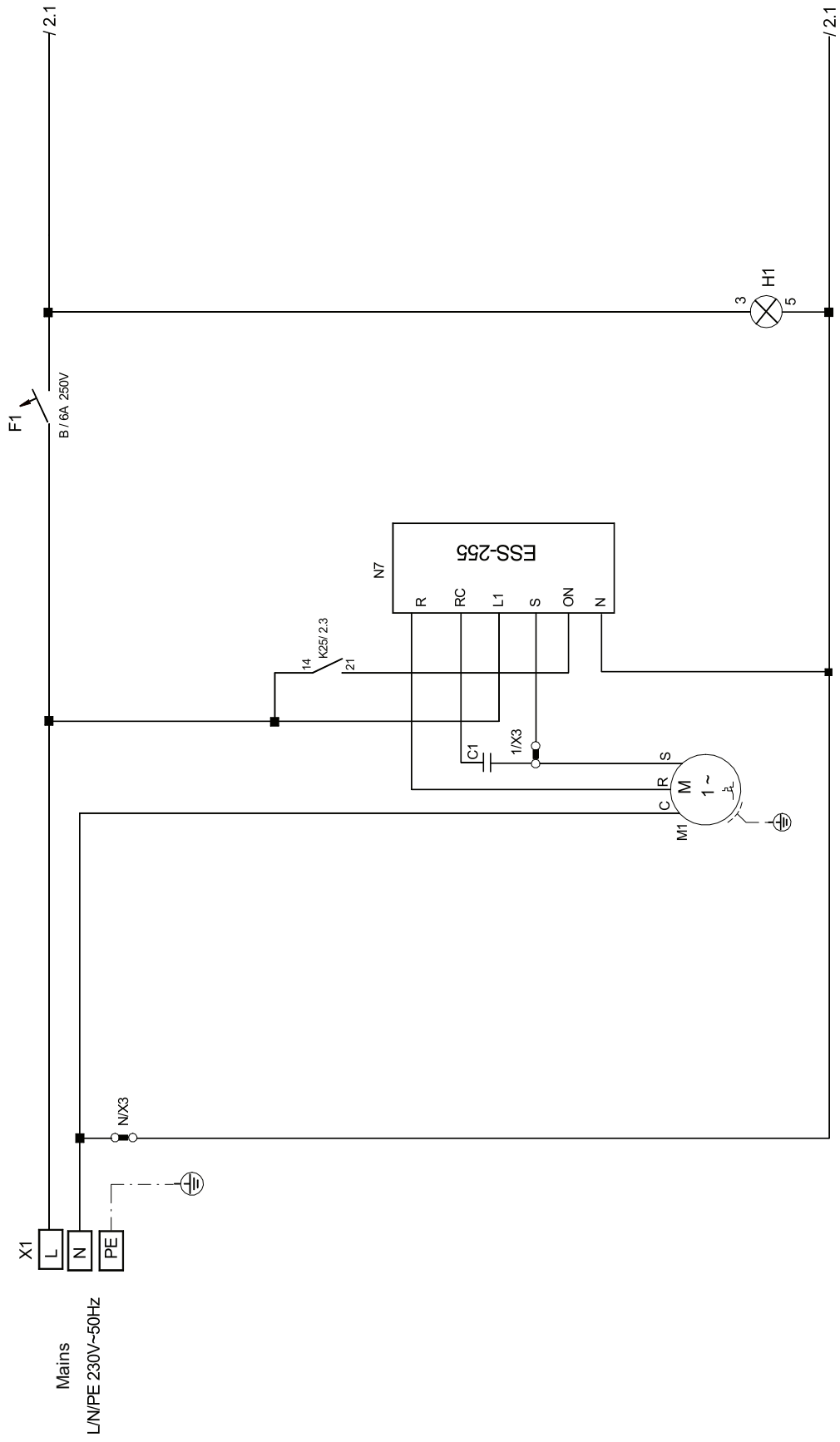
6.16 Legend LA 12TR - LA 16TR

A1	Wire jumper: The jumper must be removed for external control (via floating contact) or the use of a dew point monitor (via floating contact).
B3*	Hot water thermostat
B5	Control thermostat for supplementary heating
E3	Defrost end controller
E4	Nozzle ring heater
E10	2. 2 heat generator
F1	Control fuse
F4	High-pressure switch
F5	Low-pressure switch
F17	Safety temperature limiter - supplementary heating
F23	Thermal contact for ventilator
H1**	Indicator lamp, ready for operation
K1	Contactor for compressor
K2	Contactor, ventilator
K20	Contactor for 2nd heat generator
K24	Relay for hot water request
M1	Compressor
M2	Ventilator
M13	Heat circulating pump
N5*	Dew point monitor
N7	Soft starter
N10	Remote control
N12	Control PCB
N13*	Switching assembly, hot water
R1	External sensor
R2	Return flow sensor
R7	Coding resistor
R10*	Humidity sensor
R12	Flow sensor for cooling operation (water)
R14**	Setpoint potentiometer
R15	Flow sensor
S1**	Control switch HP ON/OFF
S2**	Changeover switch HEATING/COOLING
X1	Terminal strip for mains 3~/N/PE - 400 V AC / 50 Hz
X2	Terminal strip for external components
X5	Terminal strip for internal wiring
Y1	Four-way reversing valve, heating/cooling
Y5*	Three-way reversing valve for DHW preparation
*	Components to be supplied from external sources
**	Components are in the remote control

6.17 Control SI 8MR - SI 10MR



6.18 Load SI 8MR - SI 10MR

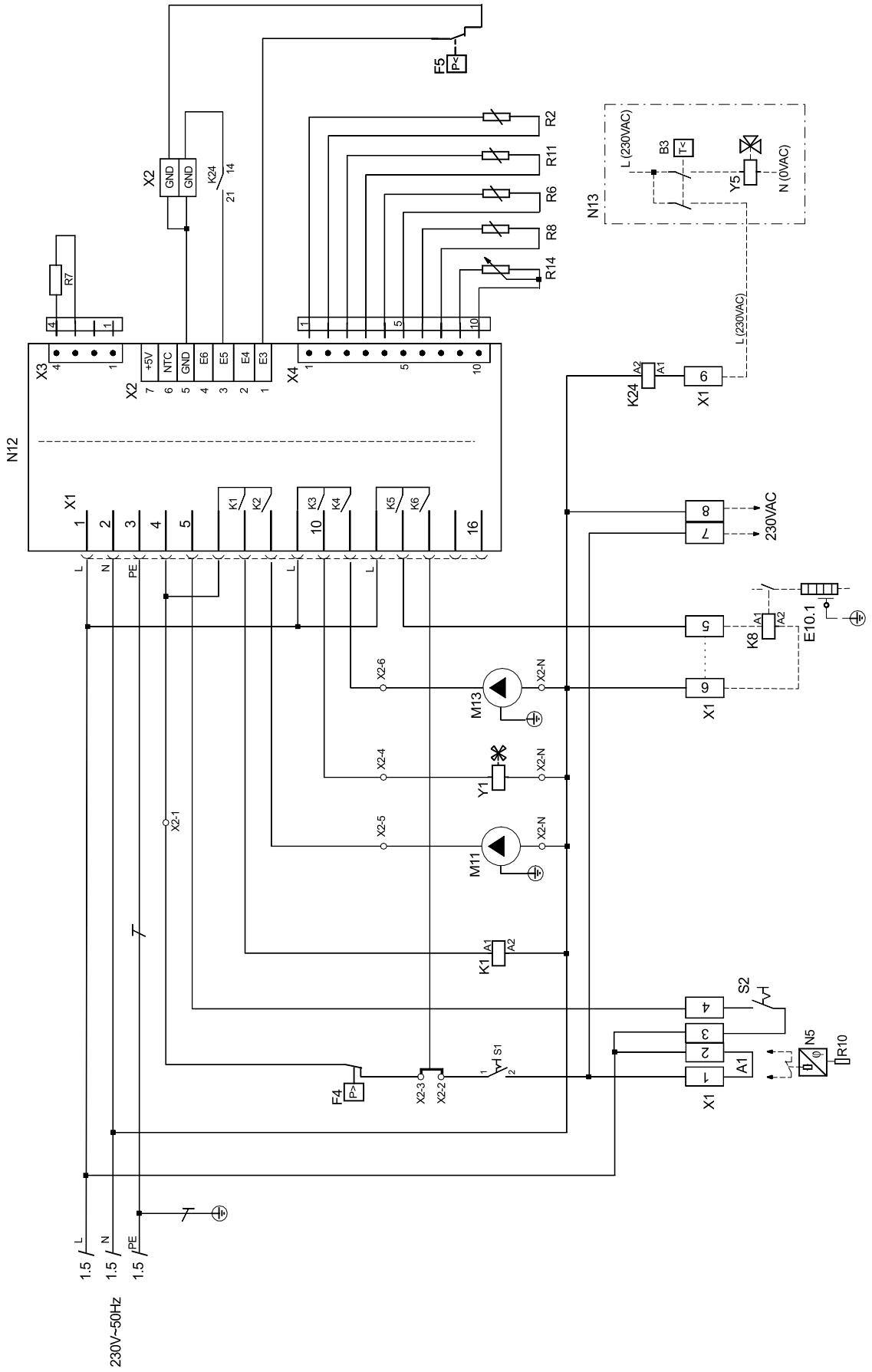


6.19 Legend SI 8MR - SI 10MR

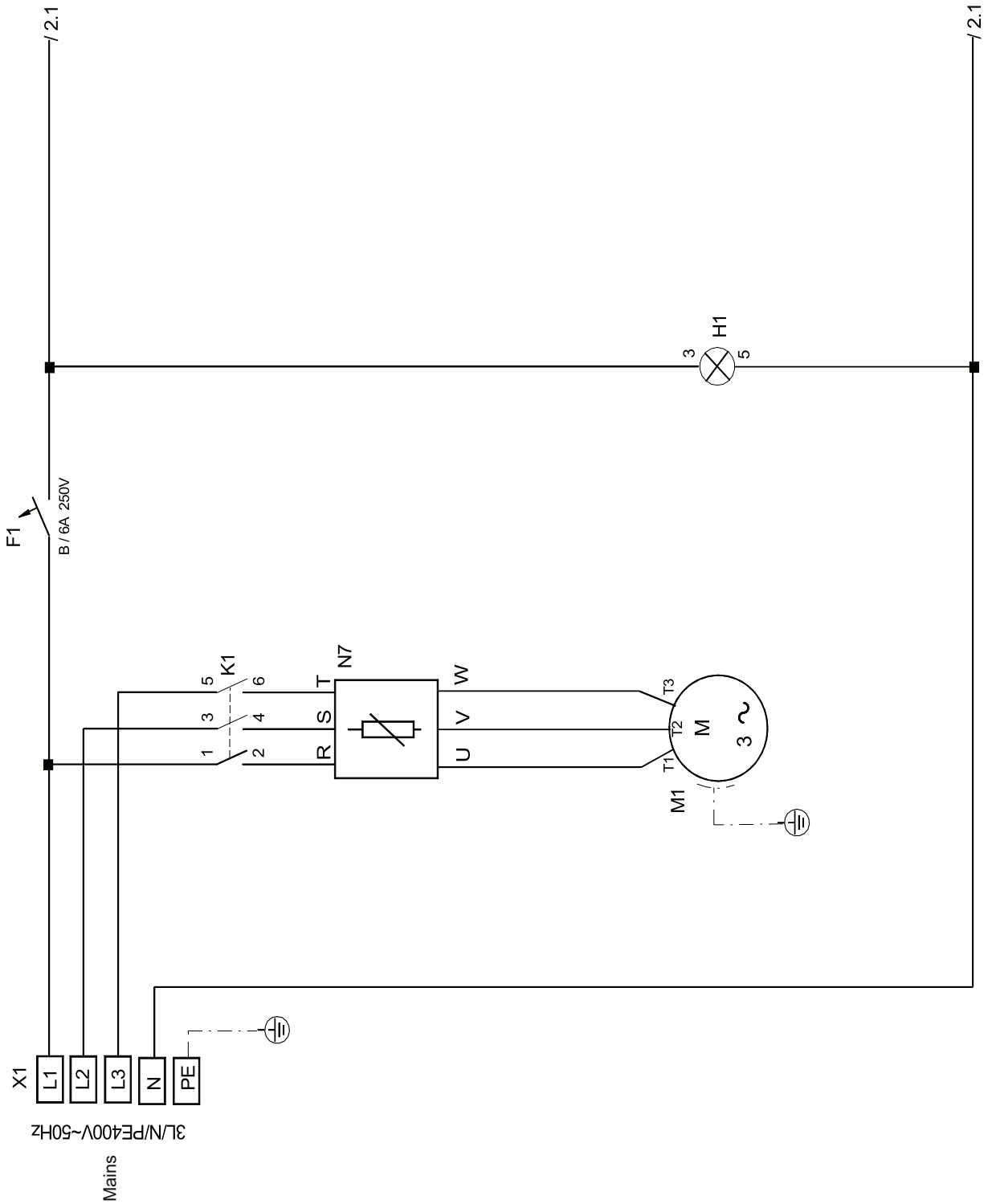
A1	Wire jumper, must be removed if external control or a dew point monitor are used
B3	Hot water thermostat
C1	Operating condenser
E10.1*	Supplementary heating
F1	Control fuse
F4	High-pressure switch
F5	Low-pressure switch
H1	Indicator lamp, ready for operation
K8*	Contactor for supplementary heating
K24	Relay, request for hot water
K25	Start relay for N7
M1	Compressor
M11	Primary circulating pump (brine)
M13	Heat circulating pump
N5*	Dew point monitor
N7	Soft starter
N12	Control PCB
N13*	Switching assembly, hot water
R2	Return flow sensor
R6	Flow temperature limit sensor (brine)
R7	Coding resistor
R8	Flow sensor for cooling operation (water)
R10*	Humidity sensor
R11	Flow sensor
R14	Setpoint potentiometer
S1	Control switch HP ON/OFF
S2	Changeover switch HEATING/COOLING (contact open = heating)
X1	Terminal strip for power supply L/N/PE-230 V AC- 50Hz/external components
X2	Terminal strip for internal wiring
X3	Terminal strip for compressor
Y1	Four-way reversing valve, heating/cooling
Y5*	Three-way reversing valve for domestic hot water preparation

* Components to be supplied from external sources

6.20 Control SI 12TR - SI 16TR



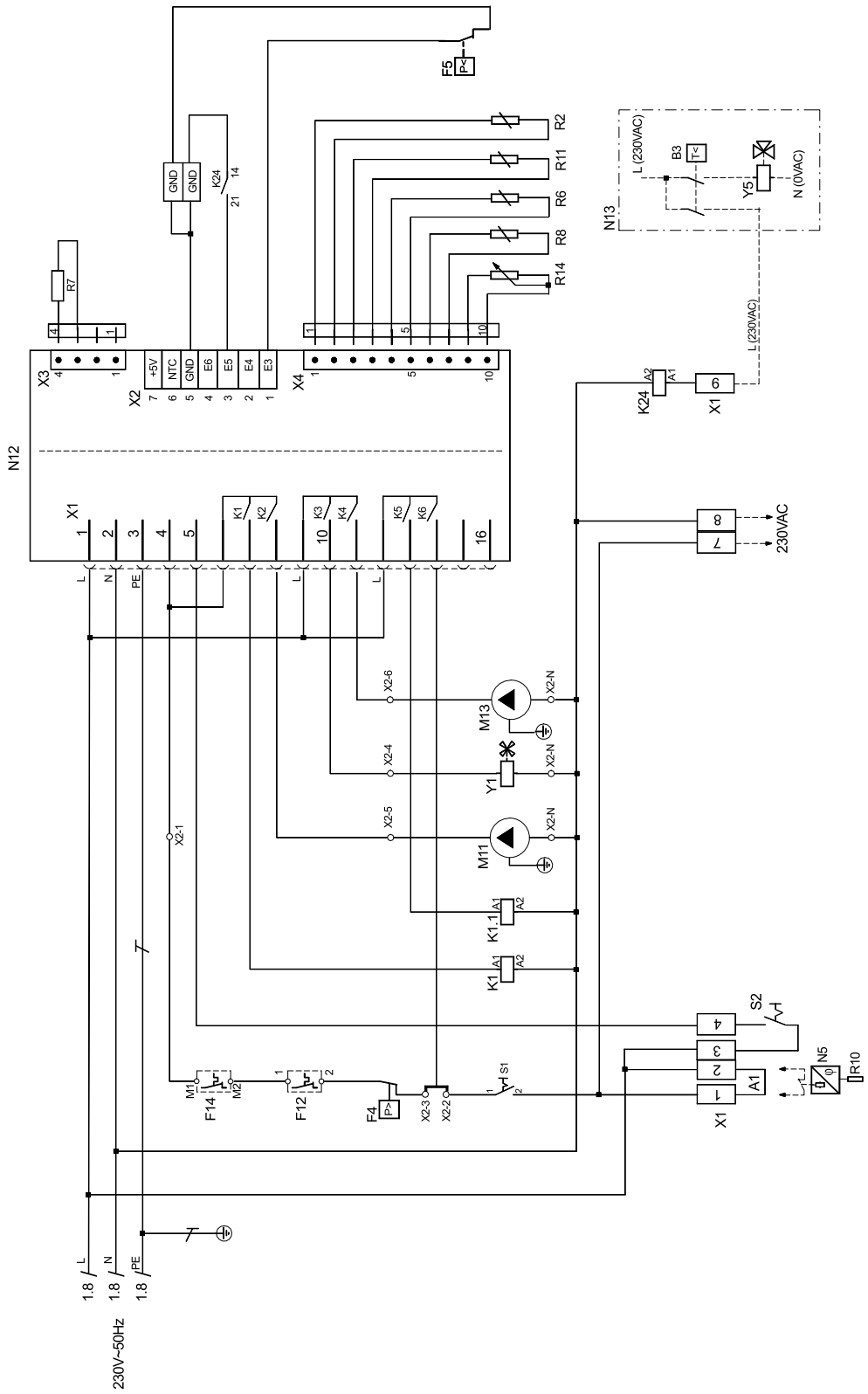
6.21 Load SI 12TR - SI 16TR



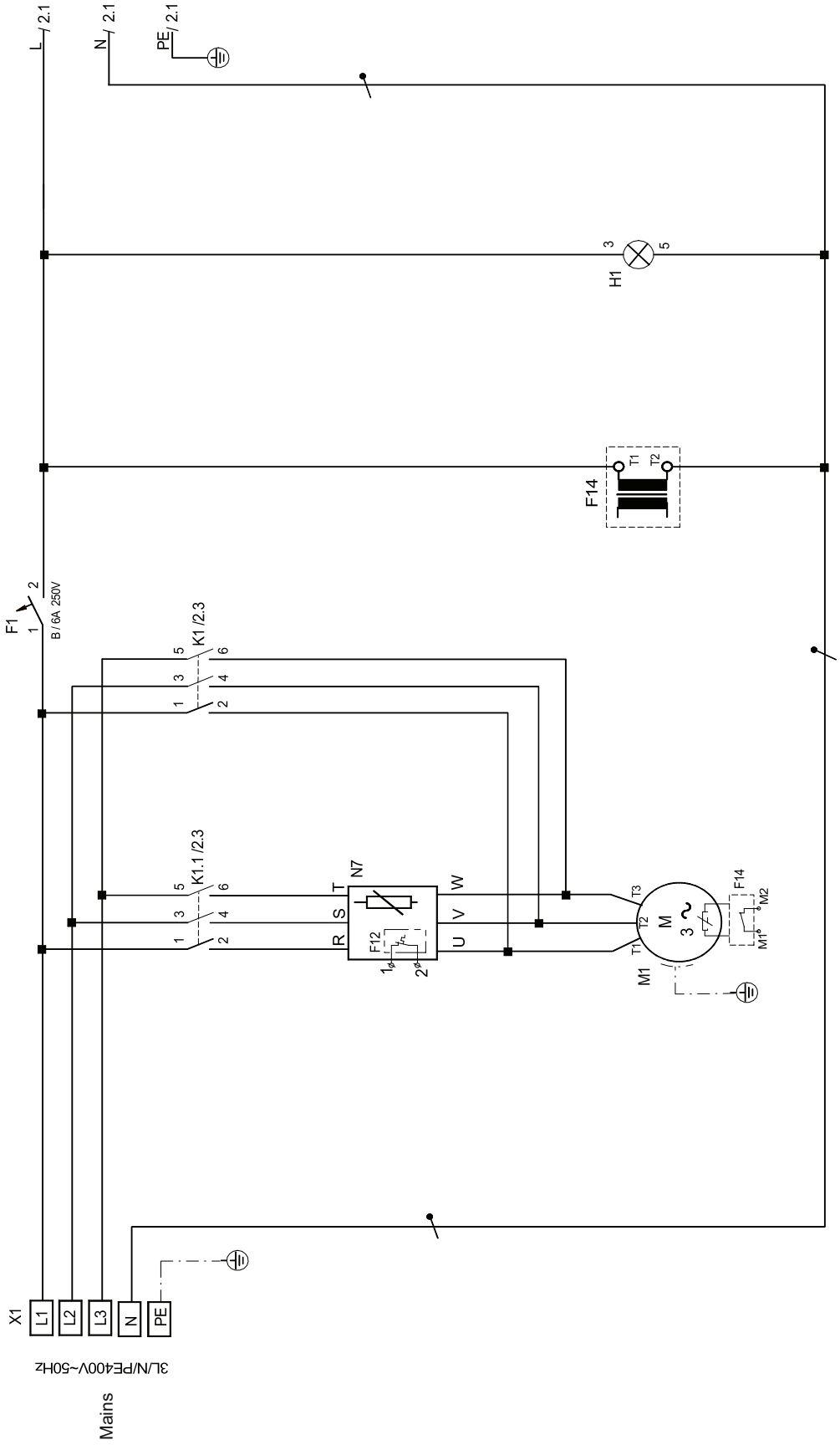
6.22 Legend SI 12TR - SI 16TR

A1	Wire jumper, must be removed if external control or a dew point monitor are used
B3	Hot water thermostat
E10.1*	Supplementary heating
F1	Control fuse
F4	High-pressure switch
F5	Low-pressure switch
H1	Indicator lamp, ready for operation
K1	Contactor for compressor
K8*	Contactor for supplementary heating
K24	Relay, request for hot water
M1	Compressor
M11	Primary circulating pump (brine)
M13	Heat circulating pump
N5*	Dew point monitor
N7	Soft starter
N12	Control PCB
N13*	Switching assembly, hot water
R2	Return flow sensor
R6	Flow temperature limit sensor (brine)
R7	Coding resistor
R8	Flow sensor for cooling operation (water)
R10*	Humidity sensor
R11	Flow sensor
R14	Setpoint potentiometer
S1	Control switch HP ON/OFF
S2	Changeover switch HEATING/COOLING
X1	Terminal strip for power supply L/N/PE-230 V AC- 50Hz/external components
X2	Terminal strip for internal wiring
Y1	Four-way reversing valve, heating/cooling
Y5*	Three-way reversing valve for domestic hot water preparation
*	Components to be supplied from external sources

6.23 Control SI 20TR



6.24 Load SI 20TR



6.25 Legend SI 20TR

A1	Wire jumper, must be removed if external control or a dew point monitor are used
B3*	Hot water thermostat
F1	Control fuse
F4	High-pressure switch
F5	Low-pressure switch
H1	Indicator lamp, ready for operation
K1	Contactor for compressor
K1.1	Contactor for starting current limiter from M1
K24	Relay, request for hot water
M1	Compressor
M11	Primary circulating pump (brine)
M13	Heat circulating pump
N5*	Dew point monitor
N7	Soft starter
N12	Control PCB
N13*	Switching assembly, hot water
R2	Return flow sensor
R6	Flow temperature limit sensor (brine)
R7	Coding resistor
R8	Flow sensor for cooling operation (water)
R10*	Humidity sensor
R11	Flow sensor
R14	Setpoint potentiometer
S1	Control switch HP ON/OFF
S2	Changeover switch HEATING/COOLING
X1	Terminal strip for power supply L/N/PE-230 V AC- 50Hz/external components
X2	Terminal strip for internal wiring
Y1	Four-way reversing valve, heating/cooling
Y5*	Three-way reversing valve for domestic hot water preparation
*	Components to be supplied from external sources

7 Control and Regulation

The elements of the simplified regulation of air-to-water heat pumps and brine-to-water heat pumps are identical. The controls are integrated in the unit with the brine-to-water heat pumps installed. By contrast, the air-to-water heat pumps installed outdoors are equipped with a remote controller which is normally installed inside the building. With the air-to-water heat pump LAK 10MR, the room temperature recording and regulation is integrated in the remote controller and must therefore be placed in the respective reference room.

The controller board is integrated in the housing of both device types and the respective cover of the heat pump must be dismantled for this purpose. The regulation elements and displays of the two heat pump type differ as described below:

7.1 Regulation and display with air-to-water heat pumps

7.1.1 Remote controller for return temperature regulation

The air-to-water heat pumps installed outdoors are equipped with a remote controller as shown in figure 7.1. This remote controller is mounted inside the building and controls all functions of the heat pump. The heat pump can be switched on with switch 1 or set to "standby" operation. The heat pump is supplied with line voltage in "standby" operation to keep the antifreeze function active. If the heating water temperatures drop below 10 °C in heating mode, the heat circulating pump is first started and if this does not lead to an increase of the heating water temperature, the compressor is also activated.

Switch 3 of the remote controller is used to switch between the two operating modes "Heating" and "Cooling". The heat pump responds to a change of the operating mode with a delay of approx. 10 min. to prevent direct switching from heating to cooling operation.

The return set temperature of the heating water can be set with setpoint regulator 4.

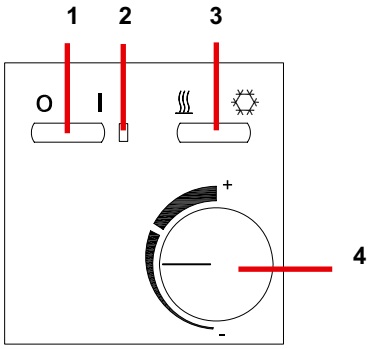


Fig. 7.1: Wall-mounted remote controller of air-to-water heat pumps

1) Switch ON/Standby
2) The green LED lights up independent of the switch position (indicating the heat pump is ready for operation)
3) "Heating switch" (left-hand position)
   "Cooling" switch (right-hand position)
4) Setpoint regulator for heating water temperature

7.1.2 Remote controller with room temperature sensor for room temperature regulation (only LAK 10MR!)

The remote control with room temperature sensor should be installed in a reference room at a suitable location (height approx. 1 m) in the building. Based on experience, a living room, for example, is a suitable reference room. Based on the temperature in this room, the entire heating of the building is then regulated. The heat pump can be switched on and off with the remote controller whereby switching off means that the heat pump is set to "standby" operation. If the heat pump is supplied with line voltage, the antifreeze function of the heat pump remains active, as already described.

Furthermore, the heating or cooling operating modes as well as the setpoint of the room temperature can be adjusted with the remote controller.

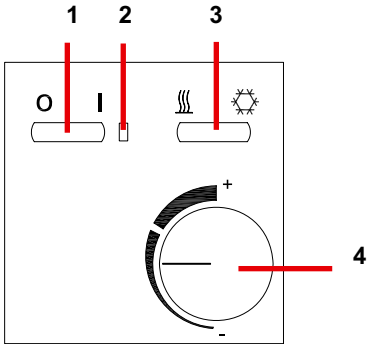


Fig. 7.2: Wall-mounted remote controller of air-to-water heat pumps

1) Switch ON/Standby
2) The green LED lights up independent of the switch position (indicating the heat pump is ready for operation)
3) "Heating switch" (left-hand position)
   "Cooling" switch (right-hand position)
4) Setpoint regulator for room temperature

7.1.3 Controller board

The current operating state of the heat pump can be read by the individual LEDs on the controller board. The LEDs indicate the following states of the heat pump:

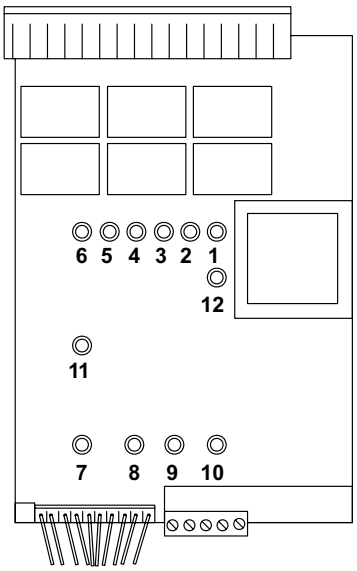


Fig. 7.3: Air-to-water heat pump controller board

1) On = Compressor running
2) On = Ventilator running
3) Off = Heat pump in "Heating" mode
   On = Heat pump in "Cooling" mode
   or in "Defrosting" mode
4) On = Heat circulating pump running
5) Off = No request to the 2nd heat generator
   (Heating element)
6) On = Antifreeze request, the heat pump is heating
7) On = Heat source without fault
   Off = Heat source fault, low-pressure switch active
8) Off = Defrosting in progress or if 2) On in heating mode
   Off = Defrosting completed or if 2) On in cooling mode
9) Not used
10) Not used
11) Flashes during operation
12) Flashes in the case of a fault

7.2 Regulation and display with brine-to-water heat pumps

7.2.1 Controls on the heat pump

The brine-to-water heat pumps installed inside are equipped with a control panel with additional pressure or temperature displays as shown in figure 7.3. All functions of the heat pump are controlled with the controls. Switch 1 switches the heat pump to operational readiness or to the "Standby" operation. In readiness operation, the heat circulating pump pump is set to continuous operation.

Switch 3 of the remote controller is used to switch between the two operating modes "Heating" and "Cooling". The heat pump responds to a change of the operating mode with a delay of approx. 10 min. to prevent direct switching from heating to cooling operation.

The return set temperature of the heating water can be set with setpoint regulator 4.

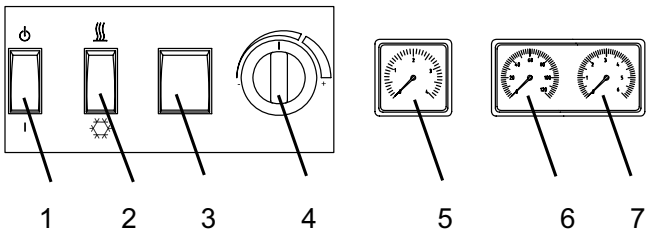


Fig. 7.4: Integrated control panel of brine-to-water heat pumps

1) Switch ON/Standby
2) Switch heating/cooling
3) Indicator (illuminates if HP voltage is on)
4) Setpoint potentiometer (return)
5) Pressure indicator for brine circuit
6) Pressure indicator for heating circuit
7) Temperature indicator for heating circuit

7.2.2 Controller board

The current operating state of the heat pump can be read by the individual LEDs on the controller board. The LEDs indicate the following states of the heat pump:

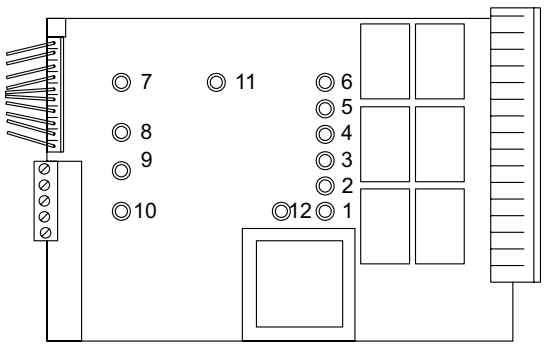


Fig. 7.5: Brine-to-water heat pump controller board

1) On = Compressor running
2) On = Brine circulating pump running
3) Off = Heat pump in "Heating" mode
   On = Heat pump in "Cooling" mode
4) On = Heat circulating pump running
5) Not used
6) On = Antifreeze request, the heat pump is heating
7) On = Heat source without fault
   Off = Heat source fault, low-pressure switch active
8) Not used
9) On = Hot water request
10) Not used
11) Flashes during operation
12) Flashes in case of a fault

7.3 Active cooling with reversible heat pumps

Cold is generated actively by reversing the process in the heat pump. The refrigerating cycle is switched from heating to cooling operation using a four-way reversing valve.

NOTE

The heat pump is blocked for 10 minutes when it is switched from heating to cooling operation. This allows the different pressures in the refrigerant circuit to equalize.

Requests are processed as follows:

- Domestic hot water before
- Cooling

The heat pump operates as in heating operation during DHW preparation.

7.4 Function descriptions

The heat pumps with simplified regulation have been designed for heating and cooling operation with fan convectors. During heating operation, a heat distribution via panel heating is possible if the temperature spread of the underfloor heating system is known. The return set temperature is then calculated from the maximum flow temperature minus the temperature spread of the underfloor heating system.

Silent cooling via underfloor heating is not possible since flow temperatures that are too low could cause a condensate failure. The simplified regulation of the heat pumps is not capable of recording or limiting the flow temperatures. Silent cooling is only possible when providing external regulation devices to limit the flow temperature in cooling operation.

Separate heat distribution in heating operation via panel heating and in cooling operation via fan convectors is possible. Switching the heat distribution system between underfloor heating and fan convectors, depending on the operating mode, must be realised via an external regulation device since the simplified control of the heat pump does not provide a respective feature.

The behaviour of the individual operating modes of the heat pumps and their simplified regulation is as described below:

7.4.1 Heating operating mode

Start the heat pump by turning the switch (1) to the ON position (I). Select the operating mode "Heating" (symbol) with switch (3). Turn the rotary knob (4) to set the desired return temperature. The scale around the rotary knob describes a selectable temperature range between min. 10 °C and max. 55 °C. The heat pump heats until the set return temperature is reached and then shuts off automatically. If the return temperature drops by 4 Kelvin below the set return temperature, the heat pump switches on again automatically.

The heat pump also shuts itself off if the flow temperature of the heating water reaches approx. 58±2 °C or the air intake temperature falls below the lower operating limit of -20 °C.

After the heat pump has switched off, a restart of the heating operation is only possible after an idle time of 5 minutes. The observation of this time interval is ensured by the control of the heat pump.

An additional 2nd heat generator in the form of an electrical heating element is integrated with air-to-water heat pumps. Depending on the switching arrangement, outputs of 2, 4 or 6 kW can be added with this heating element to support heating. The heating element is automatically activated by the control of the heat pump if, after approx. 1 hour, the set return set temperature is not reached and shuts off together with the heat pump after the return temperature has been reached.

Exception of room temperature control (only LAK 10MR)

Different to regulation of the return set temperature of the heat pump, the desired room temperature for the room temperature regulation is preselected with the rotary knob (4). The request takes place via a potentiometer and lies in the range between min. 15 °C and max. 25 °C. The level required for the heating water is calculated from the deviation in the room temperature. The heat pump is shut off when the set room temperature has been reached. The heat pump is switched on again when the room temperature drops by 2 Kelvin below the set setpoint.

NOTE

Please note that this type of room temperature regulation responds very sluggishly. Extended response times can therefore be expected after changing the room set temperature until the desired room temperature has adjusted itself.

Bathrooms, kitchens or hallways are not suitable as reference rooms since they deviate most strongly from the average temperature level of the entire building. Rooms with heavy sun exposure through large window surfaces (too warm!) or rooms facing only northward (too cold) are also unsuitable.

7.4.2 Cooling operating mode

Start the heat pump by turning the switch (1) to the ON position (I). Select the operating mode "Cooling" (symbol) with switch (3). Turn the rotary knob (4) to set the desired return temperature. The scale around the rotary knob describes a selectable

temperature range between min. 10 °C and max. 40°C. The heat pump cools until the set return temperature is reached and then shuts off automatically. If the return temperature rises by 4 Kelvin above the set return temperature, the heat pump switches on again automatically.

The heat pump also switches itself off if the heating water reaches a flow temperature of approx. 7 °C or the air intake temperature exceeds the upper operating limit.

After the heat pump has switched off, a restart of the cooling operation is only possible after an idle time of 5 minutes. The observation of this time interval is ensured by the control of the heat pump.

To prevent condensation from forming on parts of the heat pump system, it is recommended to monitor sensitive points of the cold distribution system with the help of a dew point monitor and corresponding dew point sensors. The cooling operation is interrupted if the dew points sensors register humidity build-up (see chapter 10, accessories).

Exception of room temperature control (only LAK 10MR)

The room temperature control in cooling operation works identically to the regulation in heating mode. Turn the rotary knob (4) to preselect the desired room temperature. The request also takes place via the potentiometer at the same temperature range between min. 15 °C and max. 25 °C. The level required for the cooling water is calculated from the deviation in the room temperature. The heat pump is shut off when the set room temperature has been reached. The heat pump is switched on again when the room temperature rises by 2 Kelvin above the set setpoint.

7.4.3 Hot water preparation operating mode

Start the heat pump by turning the switch (1) to the ON position (I). Hot water can be prepared with the heat pump independently of the currently set operating mode. The request must be presented with the help of external thermostats to be provided in the hot water cylinder. The request signal generated by the thermostat is processed by the control of the heat pump by switching the three-way reversal valve, required for hot water preparation, and setting the return set temperature automatically to the maximum value.

The request for hot water preparation has the highest priority so that a possibly existing or occurring heating or cooling request is put on hold for the duration of the hot water preparation. After the hot water preparation has been concluded, an existing request for heating or cooling is then resumed or the heat pump switches off.

NOTE

The heat exchanger area installed in the hot water cylinder must be dimensioned so that the maximum heat output of the heat pump can be transferred when the temperature spread remains under 10 K. The heat output especially of air-to-water heat pumps rises with the external temperature. The required heat exchanger area of the hot water cylinder must therefore be designed for the heating output of a heat pump in the summer (outside temperature approx. 25 °C).

PAY SPECIAL ATTENTION TO:

If the hot water set temperature on the thermostat is set to a value that is too high, this causes the heat pump to be shut off via the high-pressure switch and the heating or cooling operation is blocked.

7.5 Special accessories

7.5.1 Domestic hot water preparation

Hot water cylinder requirements

The standard continuous power ratings specified by the different cylinder manufacturers are not a suitable criterion for selecting a cylinder for heat pump operation. The following criteria must be taken into consideration when selecting a cylinder: the size of the heat exchanger area, the construction, the arrangement of the heat exchangers in the cylinder, the continuous power rating, the flow rate and the installation position of the thermostat.

The following criteria must be taken into consideration:

- The heat output of the heat pump at the maximum heat source temperature (e.g. air +35 °C) must also be transferable at a cylinder temperature of +45 °C.
- The cylinder temperature is lowered when a circulation pipe is used. The circulation pump should be time-controlled.
- It must be possible to tap the required amount of hot water even during shut-off times without the heat pump having to reheat.

Hot water cylinder minimum requirements

Heat pump	Volume	Order designation
LA 6MR / LA 8MR / LA 10MR	300 l	WWSP 332 / PWS 332
LA 12TR / LA 16TR	400 l	WWSP 880
SI 8MR / SI 10MR / SI 12TR	300 l	WWSP 332 / PWS 332
SI 14TR / SI 16TR	400 l	WWSP 880
SI 20TR	500 l	WWSP 900

(On the basis of the integration set-ups recommended in this manual and standard boundary conditions)

The table shows the allocation of hot water cylinders to the individual heat pumps where a hot water temperature of approx. 45 °C is reached by the operation of the heat pump (max. temperatures of the heat sources: Air: 25 °C, Brine 15 °C).

The maximum hot water temperature that can be attained with heat-pump-only operation is dependent on:

- The heat output of the heat pump
- The heat exchanger area in the cylinder
- The volume flow in relation to the pressure drop and the capacity of the circulating pump.

NOTE

Higher temperatures can be reached by larger exchanger areas in the cylinder and/or by increasing the volume flow.

PAY SPECIAL ATTENTION TO:

With reversible brine-to-water heat pumps, even higher brine inlet temperatures may be expected since the brine temperature could rise significantly during cooling operation in the summer. At higher heat source (brine) temperatures, the heat pump generates a significantly higher heating output which must then be transferred to the domestic water during hot water preparation. This must especially be kept in mind in warmer regions where more cooling than heating takes place.

Hydraulic integration via three-way reversal valve (DWUS 25)

When the heat pump is used for hot water preparation, the hydraulic integration of the hot water cycle must be achieved by using a three-way reversal valve. This three-way reversal valve, e.g. DWUS 25, must be ordered separately as an accessory.

Thermostat in the hot water cylinder (KRRV 003)

The hot water cylinder used must also be equipped with a thermostat which generates the hot water request. When the thermostat issues a hot water request to the control of the heat pump, the latter switches the three-way reversal valve and hot water preparation is enabled hydraulically. Switching the valve sets the return set temperature to the maximum value for the duration of hot water preparation.

7.5.2 Dew point monitoring in cooling operation

To prevent dew formation in the system during cooling operation, a dew point monitor can be connected instead of bridge A1. This dew point monitoring halts cooling operation in the entire system if condensation forms at vulnerable points in the distribution system. It can be used, for example, to monitor the heating circuit manifolds.

NOTE

The shut-down by the dew point monitoring represents a safety cut-off; the heat pump operation is only started again when the dew point monitoring releases the heat pump again.

Dimplex accessories:

TPW WPM dew point monitor and TPF 341 dew point sensor

The TPW WPM dew point monitor can be connected as a monitoring unit to the regulation of the heat pump. Depending on the demand, a connection of up to 5 dew point sensors on the dew point monitor is possible. This interrupts the cooling operation of the entire system if condensation forms at a dew point sensor.

NOTE

The heat pump regulation has a 230 V AC supply. A power supply of 24 V AC must be ensured via a transformer when using the TPW WPM dew point monitor!

The supply lead of the dew point sensor to the dew point monitor can be extended to 20 m using a "standard cable" (e.g. 2 x 0.75 mm) and up to 150 m when using a shielded cable (e.g. I(Y) STY 2 x 0.8 mm). Installation must always be carried out separately from live cables.

PAY SPECIAL ATTENTION TO:

If condensate develops on one of the dew point sensors, the cooling operation is interrupted until the dew point sensor has dried again.

8 Hydraulic Integration for Heating and Cooling Operation

The generated cooling capacity is distributed using the heat distribution system which is also to be configured for distributing cold water.

Condensate can form due to the low flow temperatures, especially in case of dynamic cooling. All pipework and exposed manifold fittings must be fitted with steam-resistant insulation. Vulnerable points in the cooling distribution system can also be equipped with a dew point monitor available as a special accessory. This will halt cooling operation in the event of moisture formation.

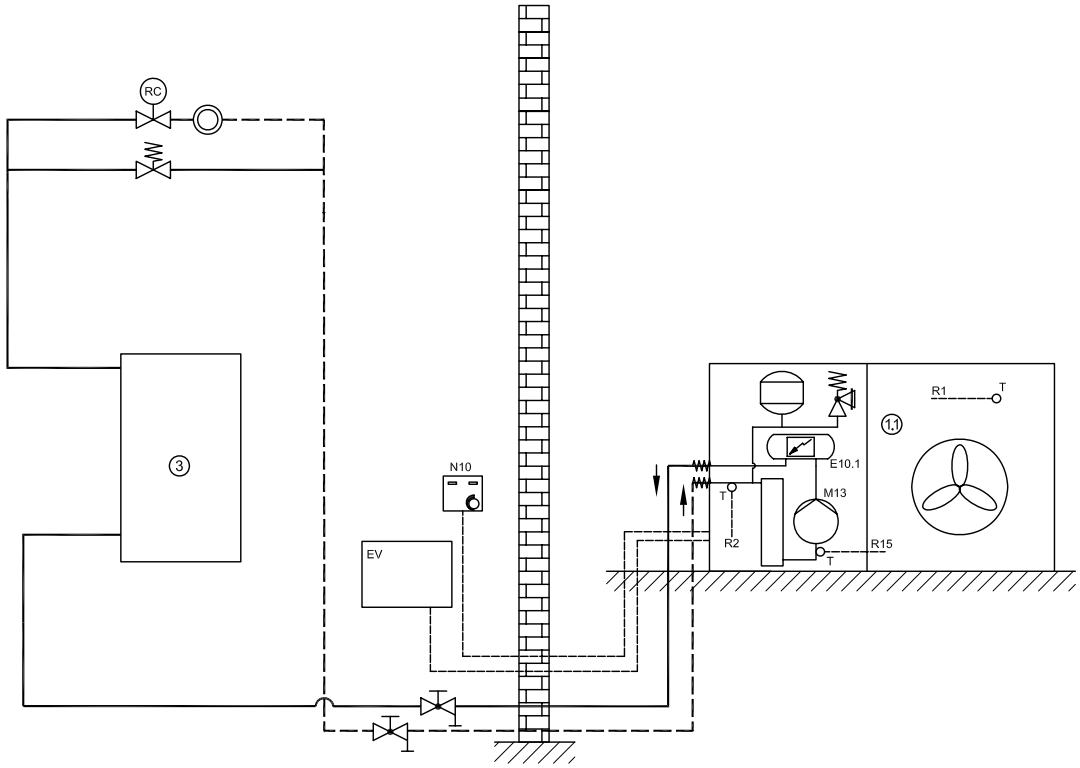
Refer to the Project Planning and Installation Manual for Heat Pumps for general information regarding the installation and integration of heat pumps.

8.1 Legend

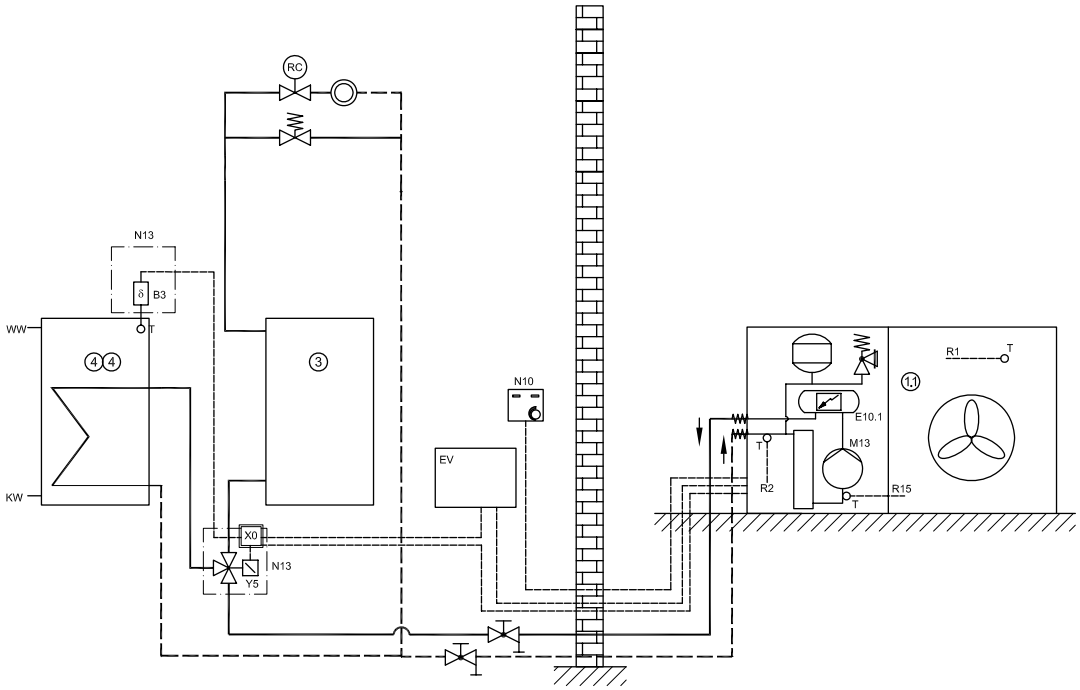
	Overflow valve
	Safety valve combination
	Circulating pump
	Expansion vessel
	Room temperature-controlled thermostat valve
	Three-way valve
	Shutoff valve with drainage
	Heat consumer
	Temperature sensor
	Flexible connection hose
①	**Air-to-water heat pump**
③	**Buffer tank**
④	**Hot water cylinder**
B3	**Hot water thermostat**
E10	**Electric heating element**
M13	**Heat circulating pump**
N10	**Remote control**
N13	**Switching assembly, hot water**
R1	**External sensor**
R2	**Return flow sensor**
R15	**Flow sensor**
Y5	**Three-way valve**
X0	**Junction box**
EV	**Electrical distribution system**
KW	**Cold water**
WW	**Domestic hot water**

8.2 Hydraulic Plumbing Diagrams Air-to-Water Heat Pumps

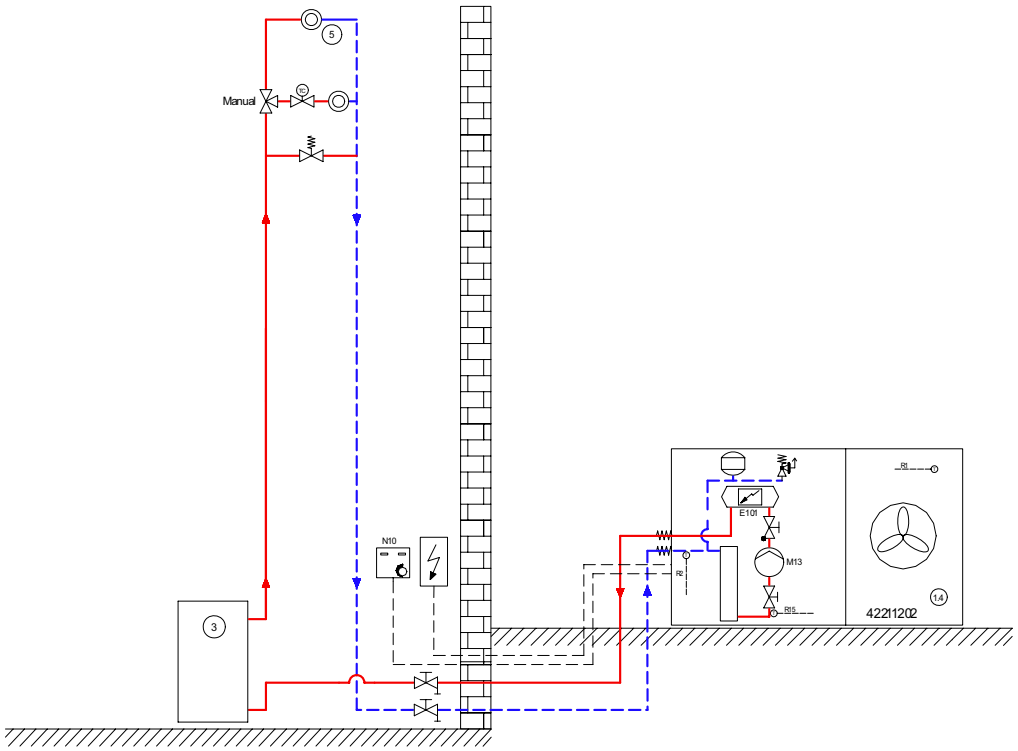
Mono Energy System



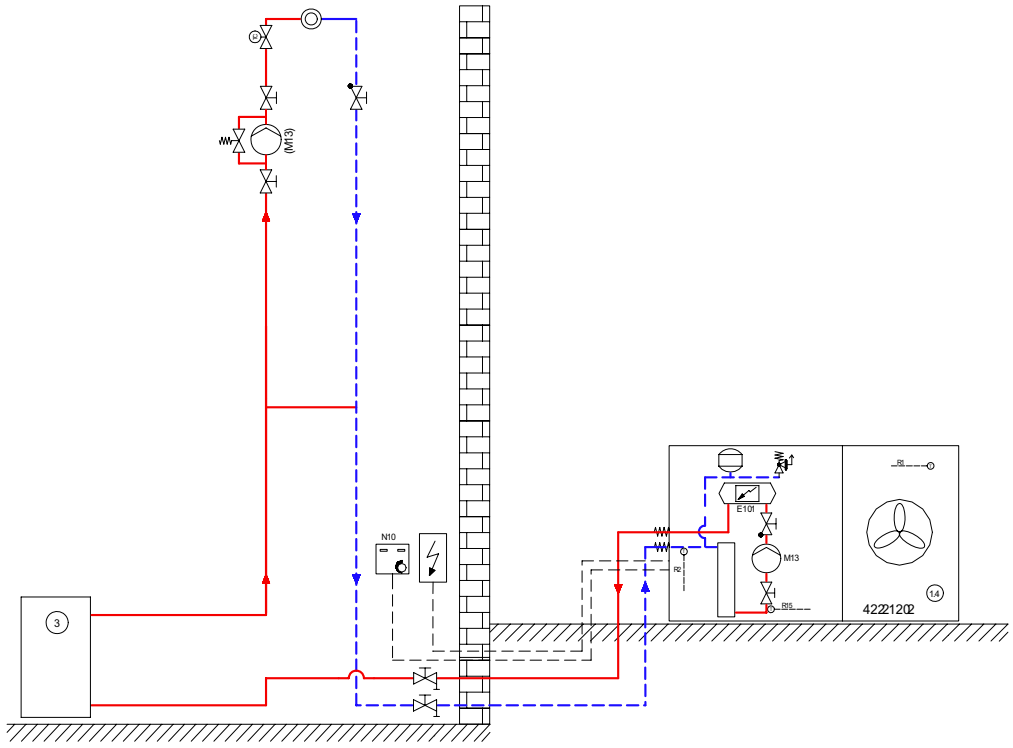
Mono Energy System and Domestic Hot Water Preparation



Mono energy system with dynamic cooling and underfloor heating



Integration diagramm for manifold without differential pressure and dynamic cooling

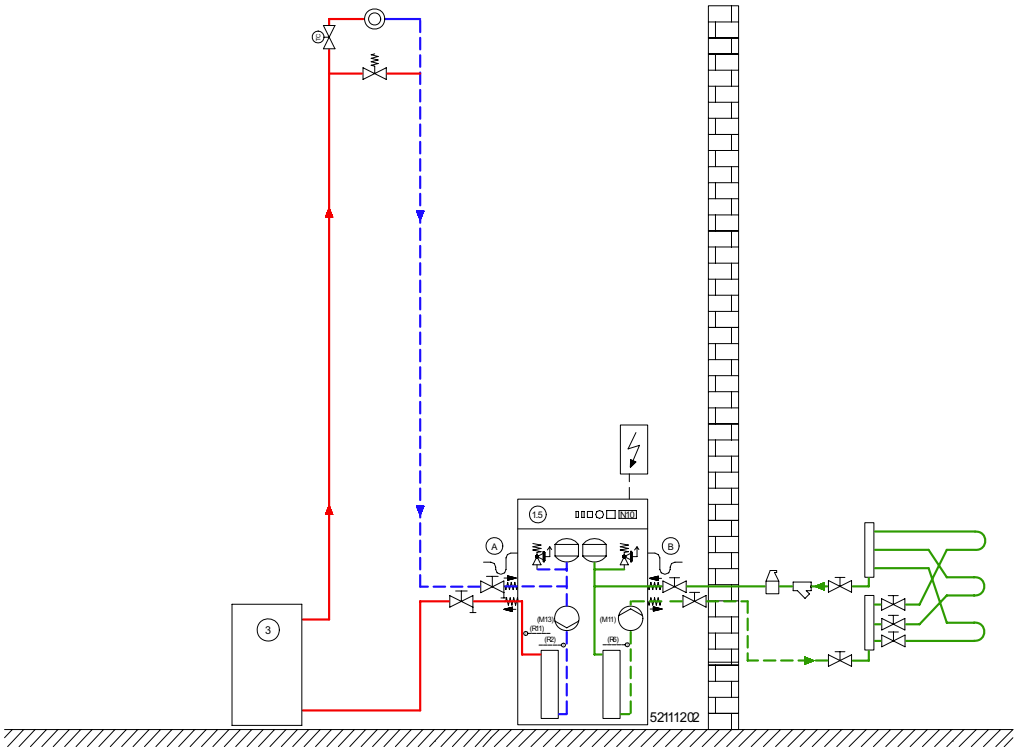


8.3 Legend

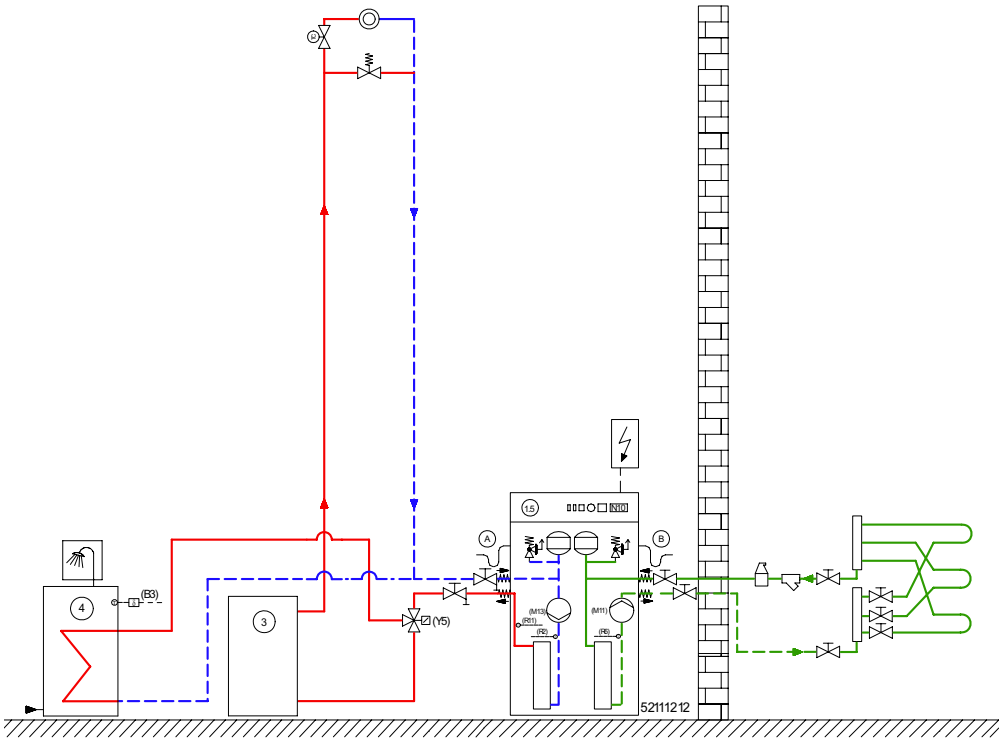
	Shutoff valve
	Overflow valve
	Safety valve combination
	Circulating pump
	Expansion vessel
	Room temperature-controlled valve
	Three-way valve
	Heat consumer
	Temperature sensor
	Flexible connection hose
⑫	**Brine-to-water heat pump**
③	**Buffer tank**
④	**Hot water cylinder**
⑬	**Borehole heat exchangers**
Ⓐ	**Overpressure of the heating system**
Ⓑ	**Overpressure of the brine**
EV	**Electrical distribution system**
KW	**Cold water**
WW	**Domestic hot water**
E10.1	**Electric heating element**
B3	**Hot water thermostat**
M11	**Primary circulating pump**
M13	**Heat circulating pump**
R2	**Return flow sensor**
R6	**Flow temperature limit sensor, brine**
R11	**Flow sensor**
Y5	**Three-way valve**

8.4 Hydraulic Plumbing Diagrams for Brine-to-Water Heat Pumps

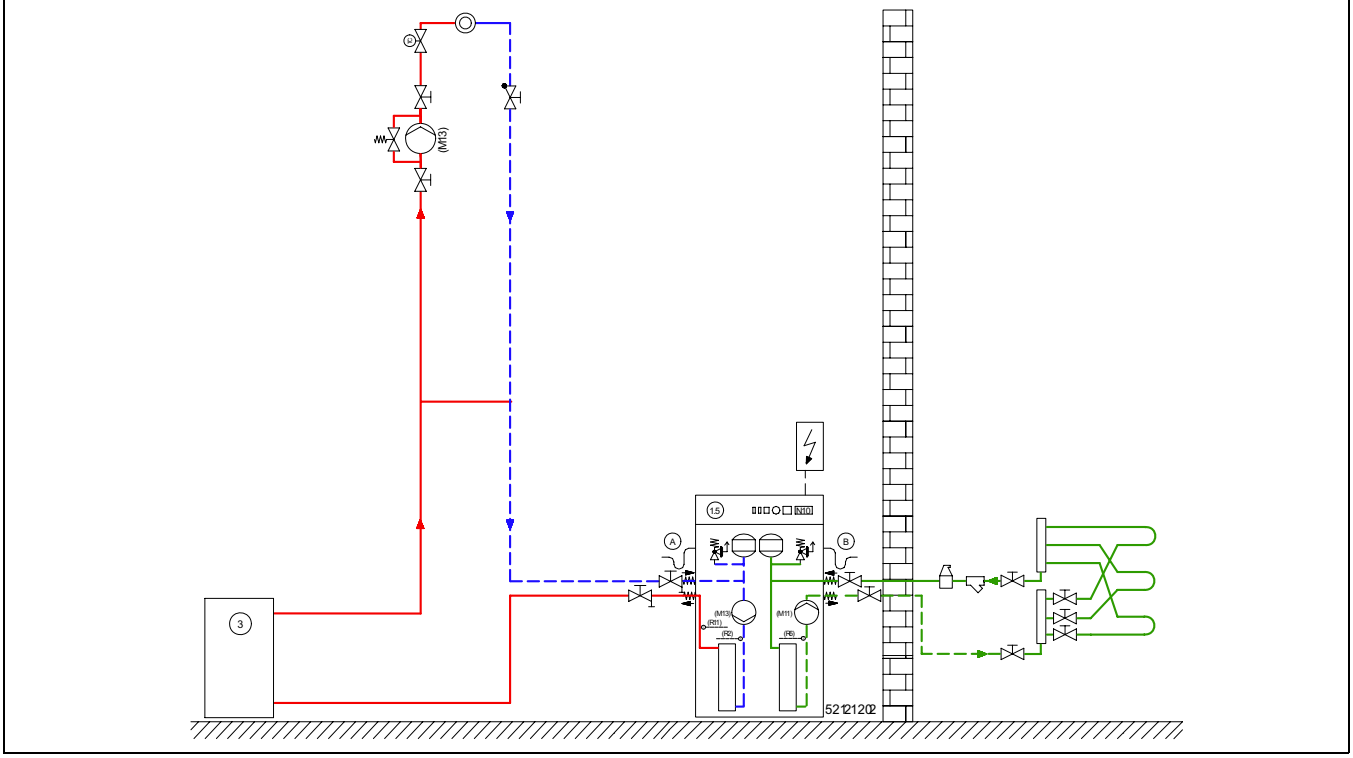
Heating and dynamic cooling



Heating and dynamic cooling and hot water preparation



Heating and dynamic cooling without differential pressure



8.5 Checkliste Wärmepumpe mit vereinfachter Regelung (WPC-Platine)

System Location:
Name:
Street:
Postal Code / Town:
Telephone:
Contact Person:

Device Data:	
Type:	
Manuf./Serv. No.:	MD:
Start-up Date:	
Start-up By:	
Warranty Time Extension: ☐ Yes ☐ No	

LA 6MR, LA 8MR, LA 10MR, LA 12TR and LA 16TR | **LAK 10MR** | **SI 8 MR, SI 10 MR, SI 12 TR, SI 14 TR, SI 16 TR and SI 20 TR**

1 Does the **hydraulic integration** match the specifications in the operating and assembly instructions? ☐ Yes ☐ No

Comment:

2 Is a **second heat generator** (E10) connected electronically and released? ☐ Yes ☐ No

3 **Wiring heat pump** <==> **remote control** error free? ☐ Yes ☐ No

Additional for LAK 10MR: Has the remote control <u>with room temperature sensor</u> been installed in a reference room and can interferences be ruled out at the location? ☐ Yes ☐ No

Resistance Set Value Potentiometer R14:

Left-hand Stop: _____ Ohm ($R14_{leftSet}$ 2kOhm)

Right-hand Stop: _____ Ohm ($R14_{rightSet}$ 8kOhm)

Resistance Set Value Potentiometer R14:

Left-hand Stop: _____ Ohm ($R14_{leftSet}$ 14.1 kOhm at 20°C; 12.0 kOhm at 25°C)

Right-hand Stop: _____ Ohm ($R14_{leftSet}$ 20.0 kOhm at 20°C 18.0 kOhm at 25°C)

Measured at room temperature __°C

Resistance Set Value Potentiometer R14:

Left-hand Stop: _____ Ohm ($R14_{leftSet}$ 2kOhm)

Right-hand Stop: _____ Ohm ($R14_{rightSetI}$ 8kOhm)

4 **Bridge A1** (terminals 3 and 2 at terminal strip X2) inserted (contact open = block) ☐ Yes ☐ No

Bridge A9 (terminal strip X5–GND and N12-X2-4) inserted to limit the flow temperature ☐ Yes ☐ No

5 Check **coding resistor.** R7 / R 7.1: _____ Ohm R7.2: _____ Ohm

Terminals (X3-3/4): R7 set = 3.9 kOhm

Terminals (X3-3/4): R7.1 set = 3.9 kOhm
Terminals (X3-1/2): R7.2 set = 10.0 kOhm

Terminals (X3-3/4): R7 set = 47 kOhm

6 Check **sensor arrangement**, **wiring** and **resistance values.**

NTC10 characteristic:	67.7/-20	53.4/-15	42.3/-10	33.9/-5	27.3/0	22.1/5	18.0/10	14.9/15	
[Resistance value in kOhm / temperature in °C]	12.1/20	10.0/25	8.4/30	7.0/35	5.9/40	5.0/45	4.2/50	3.6/55	3.1/60

External sensor R1 _____ Ohm

Return flow sensor R2 _____ Ohm

Flow sensor - cooling operation R12 _____ Ohm

Flow sensor R 15 _____ Ohm

Return flow sensor R2 _____ Ohm

Sensor limit value R6 (brine) _____ Ohm

Flow sensor - cooling operation R8 _____ Ohm

Flow sensor R11 _____ Ohm

7 **Speed level circulating pump** max.? ☐ Yes ☐ No

8 Check **setting of the <u>customer-supplied</u> overflow valve in heat pump heating operation** (second heat generator deactivated in unfavourable operating state (all lockable heating circuits closed except one e.g. bathroom).

Temperature spread between heating flow and return flow: _____ K

Max. permissible temperature spread in relation to the heat source temperature

-20 to -15°C: 4 K | -14 to -10°C: 5 K | -9 to -5°C: 6 K | -4 to 0°C: 7 K | 1 to 5°C: 8 K | 6 to 10°C: 9 K
11 to 15°C: 10 K | 16 to 20°C: 11 K | 21 to 25°C: 12 K | 26 to 30°C: 13 K | 31 to 35°C: 14 K

9 **Operating Temperature Limits / Minimum Flow**

<u>Air as heat source:</u> min. -20 °C / max. +35°C;
Heating return temperature min. +18°C
(device defrosting is stopped at a flow temperature of 10°C)

<u>Brine as heat source:</u> min. -5 °C / max. +25°C
(brine concentration min. 25%)

Brine temp. spread [K] with nom. brine flow: heating operation flow 35°C / 50°C

		SI 8MR	SI 10MR	SI 12TR	SI 14TR	SI 16TR	SI 20TR
Nominal brine flow [m³/h]		2.3	3	3	3.5	3.8	3.5
Brine inlet temperature [°C]	**25**	5.3/4.9	5.3/4.8	5.3/4.8	5.0/4.6	5.1/4.6	6.9/6.0
	20	4.8/4.4	4.8/4.3	4.8/4.3	4.6/4.2	4.7/4.3	6.4/5.5
	15	4.4/3.9	4.3/3.8	4.3/3.8	4.1/3.8	4.3/3.9	5.8/5.0
	10	3.9/3.4	3.8/3.3	3.8/3.3	3.7/3.3	3.9/3.5	5.3/4.5
	5	3.4/2.9	3.4/2.9	3.4/2.9	3.3/2.9	3.6/3.1	4.8/4.0
	0	2.9/2.3	2.9/2.4	2.9/2.4	2.9/2.5	3.2/2.7	4.2/3.5
	-5	2.4/1.8	2.4/1.9	2.4/1.9	2.4/2.1	2.8/2.4	3.7/3.0